

Overview



Features:

- **Retina Display:** 13-inch (diagonal) Retina display
- **Ports:** Two 30W Thunderbolt 3 ports and an audio port. For more information, refer to [HT204303: Identify the ports on your Mac](#).
- **Input Devices:** Force Touch Trackpad and keyboard with butterfly mechanisms
- **Finishes:** Space Gray, Silver, and Gold

For full technical specifications, refer to AppleCare Tech Specs: support.apple.com/specs/

Important Service Considerations

This computer model's design requires special service considerations:

- **Battery:** The battery is a replaceable part. For repair instructions, refer to [RP1461: Battery](#).
- **Speakers:** The speakers must be replaced as a pair. For repair instructions, refer to [RP1460: Speakers](#).
- **Trackpad:** The trackpad is a replaceable part. For repair instructions, refer to [RP1462: Trackpad](#).
- **Apple T2 Security Chip:**
 - For Macs with the Apple T2 Security Chip, the repair process is not complete for certain parts replacements until the AST 2 System Configuration suite has been run. Failure to perform this step will result in an inoperative system and an incomplete repair. This suite must be run anytime the logic board is removed from the MacBook Air (Retina, 13-inch, 2018) and when a logic board and/or Touch ID board is replaced. For more information, refer to [TP1657: System Configuration for Macs with the Apple T2 Security Chip](#)
 - Desktops and notebooks that have the Apple T2 Security Chip include security features that require a specific process for transferring data. Data from a damaged logic board can **sometimes** be captured and transferred

before any service. For more information, refer to [TP1658: Data Transfer for Macs with the Apple T2 Security Chip](#).

- **Trackpad Calibration:** The trackpad must be calibrated after every repair. Refer to [TP1314: Trackpad Calibration Check](#).
- **Audio Board:** When replacing the audio board, be sure to order the correct part color. Refer to the [TP1698: Exploded View](#) for part numbers.

macOS

MacBook Air (Retina, 13-inch, 2018) ships with a model-specific version of macOS. Refer to [HT201686: Use the Mac operating system that came with your Mac, or a compatible newer version](#) to check that the system build is correct for this computer model. Using Software Update, check for and apply the latest software and firmware updates.

Fixtures and Special Tools

- Torque driver, adjustable, 10–34 Ncm (923-02995)
- T5 Bit, 1/4" hex, 25 mm (923-02996)
- Torque driver, adjustable, 0.3–1.2 Nm (923-0735)
- Battery and speaker adhesive (076-00411)
- Protective battery cover (923-03021)



- iPhone Display Press (661-08916)



- Battery press plate and support frame (923-03007)



- Trackpad gap offset tool (923-02998)



- Weight Placement Rubber Template (923-02462)



- Touch ID alignment tool kit (932-03032)



Serial Number Location

System Serial Number

The system serial number is etched on the bottom case near the hinge.



Transferring the Serial Number

Use a fine-tip permanent marker to write the system serial number on the inside of the bottom case.



XOOYYOXYXYOO

Battery Safety Setup

Battery Safety Setup for MacBook and MacBook Pro (Mid 2012 and later)



Warning: Before servicing a portable computer, read and understand article [OP24: Safely handling lithium batteries and lithium battery-powered devices](#).

For information on how to set up your workstation, refer to article [OP685: About embedded battery safety](#).

Data Transfer for Macs with the Apple T2 Security Chip

Desktops and notebooks that have the Apple T2 Security Chip include security features that require a specific process for transferring data. Data from a damaged logic board can sometimes be captured and transferred before any service.

Important:

- This process will leave the customer system in a recovery state that makes the system appear unresponsive. To recover the system following data transfer, perform a restore using Apple Configurator 2. For more information on Apple Configurator 2 refer to [Restore Apple desktop computers that have the Apple T2 Security Chip](#) and [Restore Apple portable computers that have the Apple T2 Security Chip](#).
- Files and folders cannot be modified or deleted from the customer computer volumes. Those volumes are intended to be read only.
- After the transfer process, some files such as .bin, .etc, .tmp, and .usr may be visible on the external hard drive. This is expected behavior. Do not delete or modify these files or folders as doing so may cause issues for the customer when they migrate information from the external hard drive back to the customer's computer.
- It can take 10–20 minutes for the external hard drive to be partitioned.
- When transfer is complete, return the hard drive with the customer's data to the customer. Explain how they can migrate their data back to their computer using migration assistant.

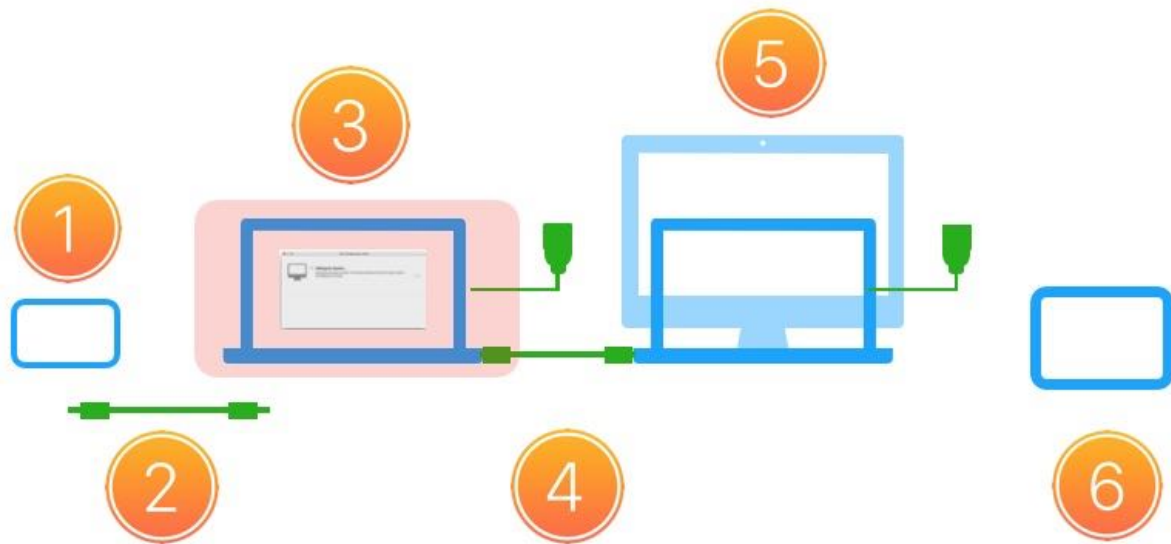
For video instruction, refer to [SV373: Macs with the Apple T2 Security Chip: Data Transfer to an External Hard Drive](#).

Tools:

- Power cord
- USB-C to USB-C Charge Cable included with portables (661-06670) or USB-A to USB-C Apple TV Restore Cable (923-00504)



- Customer's computer with a compatible keyboard and mouse or trackpad connected via USB (desktops only).
- A host computer with:
 - macOS Mojave 10.14 or later and the latest version of iTunes installed.
 - Mac Configuration Utility (MCU) installed. For information on how to set up the host computer, refer to [OP476: Latest Apple Service Toolkit download links and documentation](#).
 - Internet connection.
- An external hard drive of equal or greater capacity than the installed system storage. **Note:** The hard drive will be configured and password protected with the customer's computer serial number during the process.
- iPad or other device used to create an Apple Service Toolkit 2 (AST 2) diagnostic session.



1. External hard drive
2. External hard drive cable
3. Host computer
4. Thunderbolt 3 (USB-C) to Thunderbolt 3 (USB-C) or Thunderbolt 3 (USB-C) to USB-A cable
5. Customer's computer (Apple T2 Security Chip-based desktop or notebook)
6. iPad or other device running AST 2 with access to GSX

Steps:

1. Verify that part 076-00399 Data Transfer Setup (Retail) or 076-00410 Data Transfer Setup - Transaction Only (ASP) has been added to the repair and saved.
2. Launch the Diagnostic Console (diagnostics.apple.com) and start an AST 2 diagnostic session using the customer computer serial number.
3. Connect the customer's computer to the host computer. If the host computer does not have a USB-C port, use a USB-C to USB-A cable. It is important to connect the USB-C cable to the correct port or the process will not run.
 - For notebooks: Use only the USB-C port closest to the caps lock key.



- For iMac Pro: Use only the USB-C port closest to the Ethernet port.



- For Mac mini (2018): Use only the USB-C port closest to the HDMI port.



4. Verify that the host computer is turned on, connected to power, and connected to the Internet.

5. Start up the customer's computer in DFU mode.

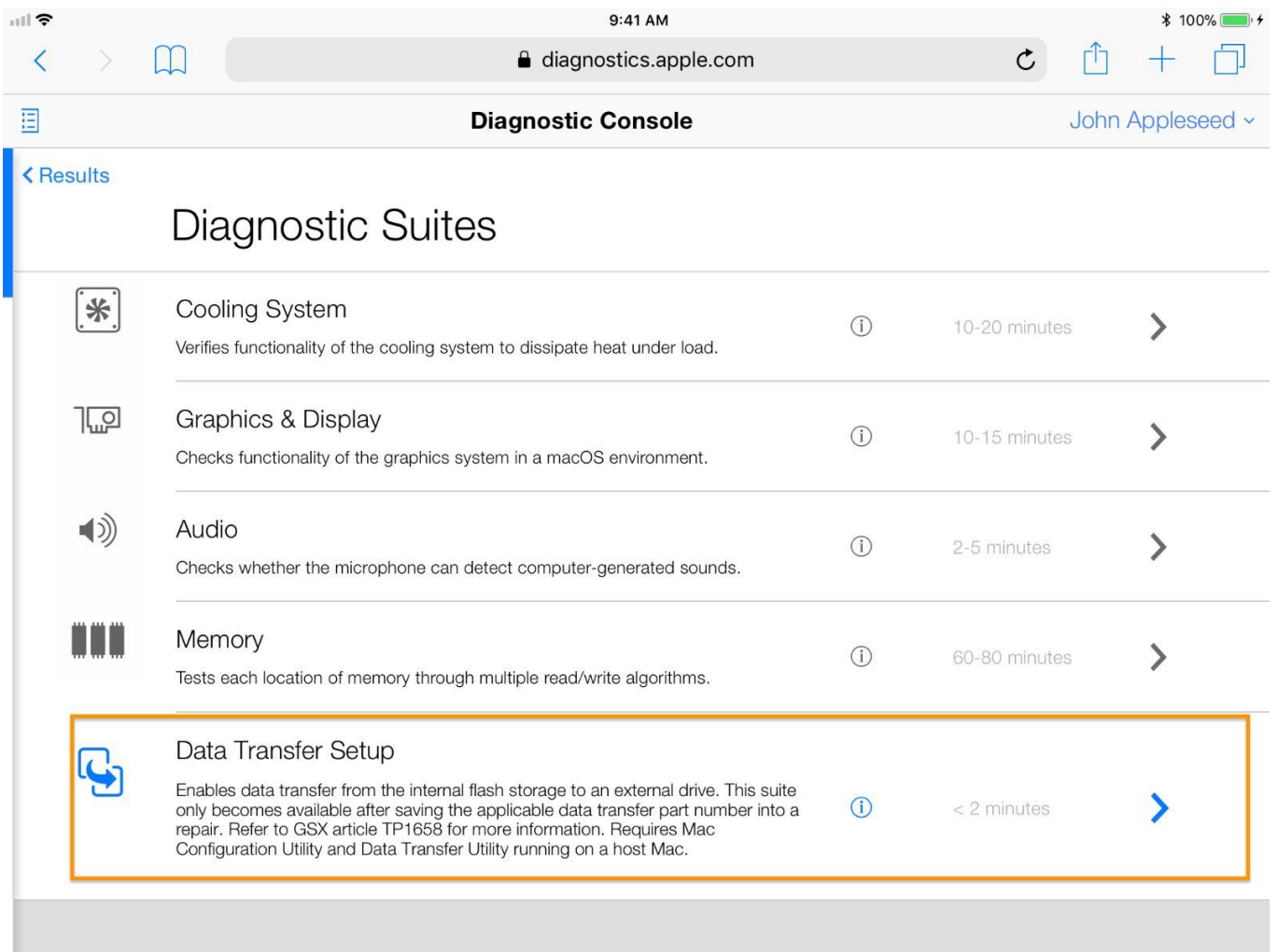
- For desktops: Press and hold the power button on the rear enclosure and connect the power cord. Continue to hold the power button until you see the device appear in Mac Configuration Utility, which may take up to 10 seconds.
- For notebooks: Press and hold the power button, then press and hold Left Control-Left Option-Right Shift until you see the device appear in Mac Configuration Utility, which may take up to 10 seconds.



6. MCU will automatically launch and a dialog box will appear on the host computer screen.



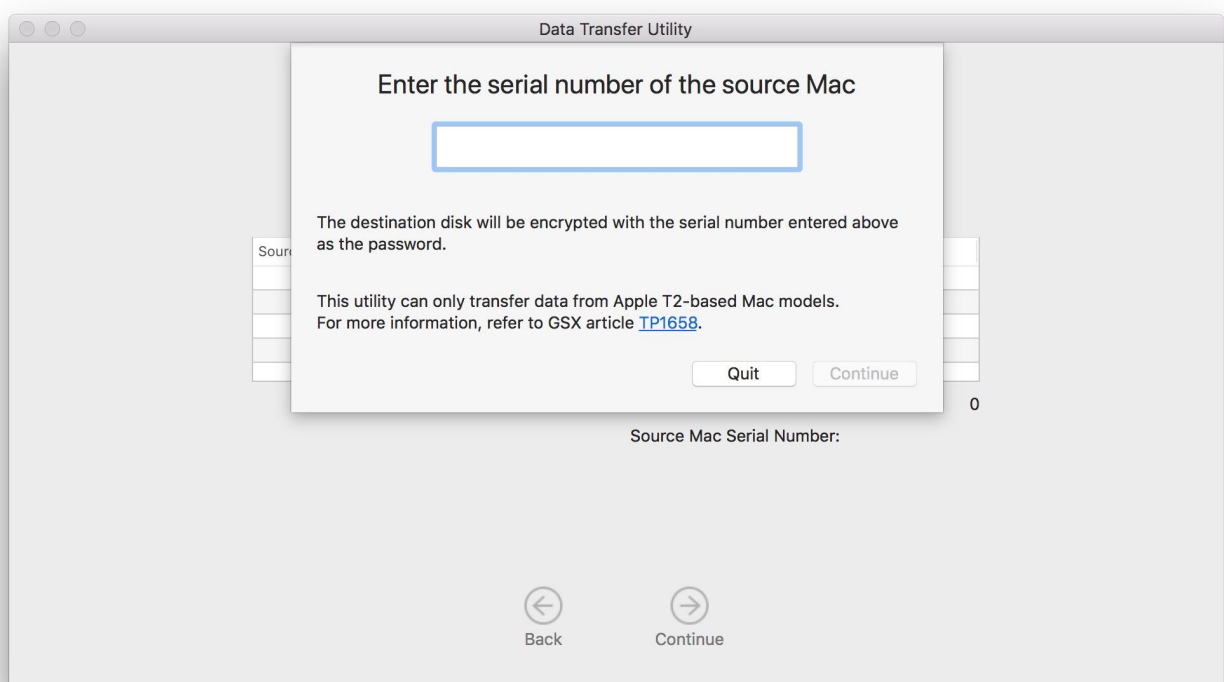
7. From the list of diagnostic suites in the Diagnostic Console, select Data Transfer Setup.



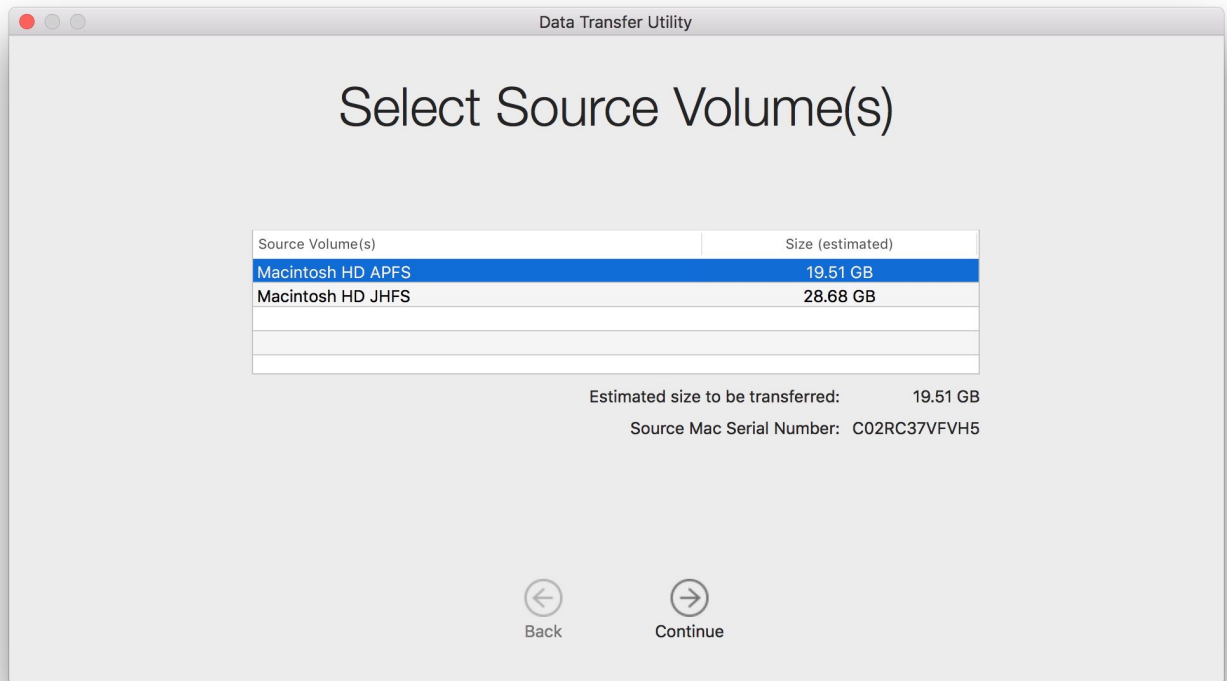
Note:

- If the customer has file vault enabled, you will be prompted to enter the password.
- The customer's computer will not display anything on the screen to indicate status. The only observable indication will be when the drive mounts as an external volume on the host Mac running MCU.

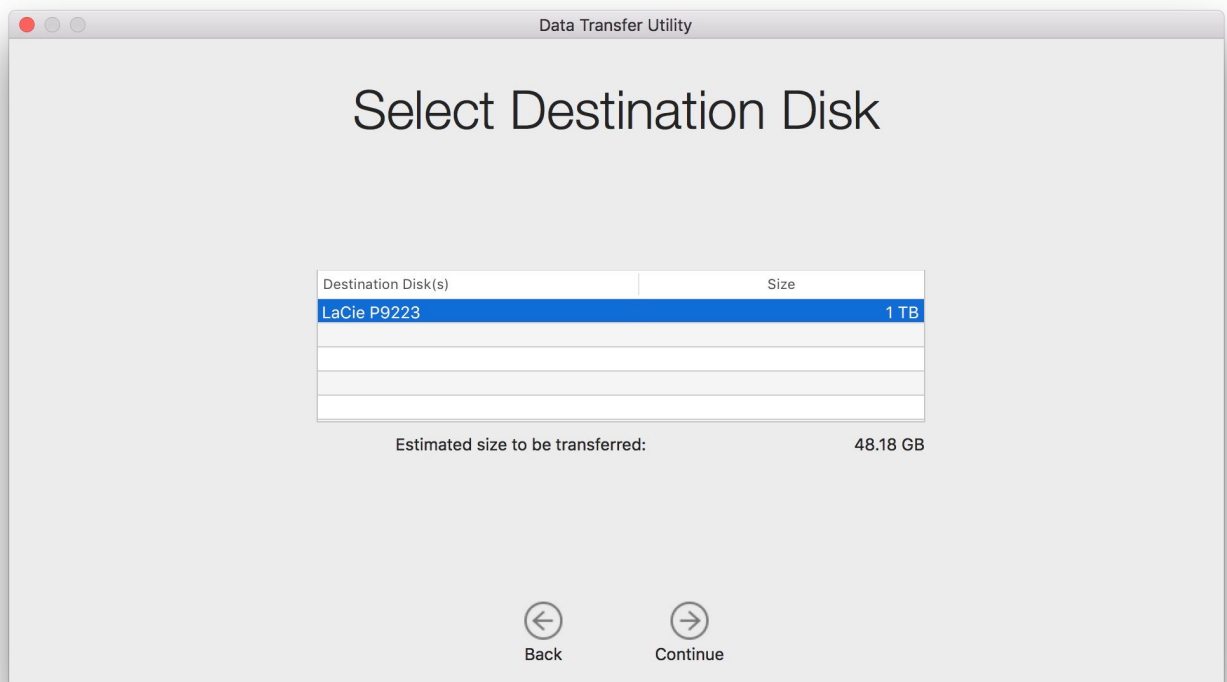
8. Open the Data Transfer Utility app on the host machine and enter the serial number of the customer's computer.



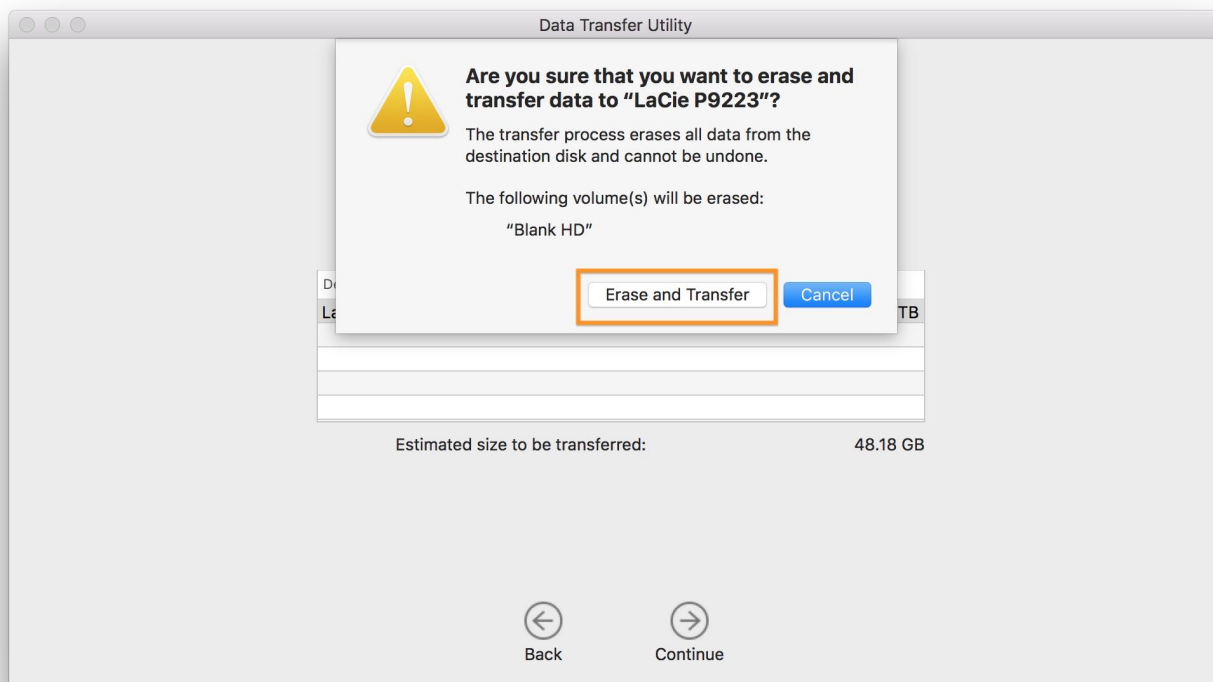
9. Select the source volume(s) and click Continue. **Note:** If more than one source volume is available, multiple volumes can be selected to be transferred.



10. Connect an external hard drive to the host machine. Select the destination, and click Continue.



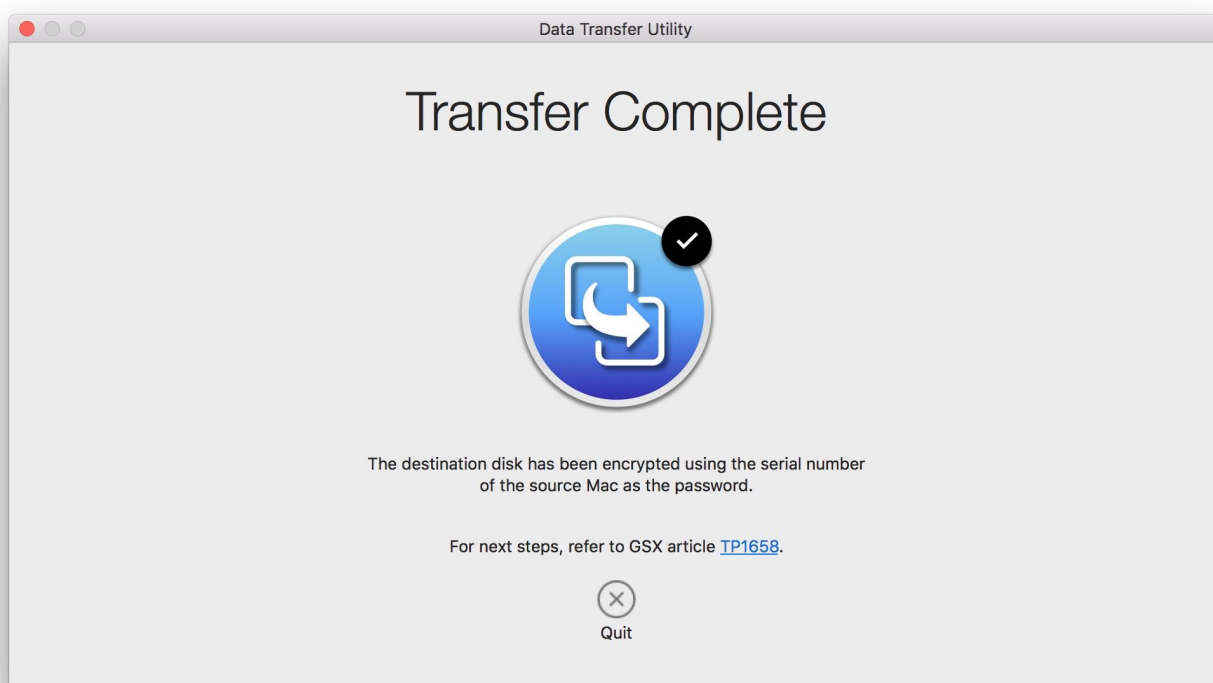
11. Click Erase and Transfer.



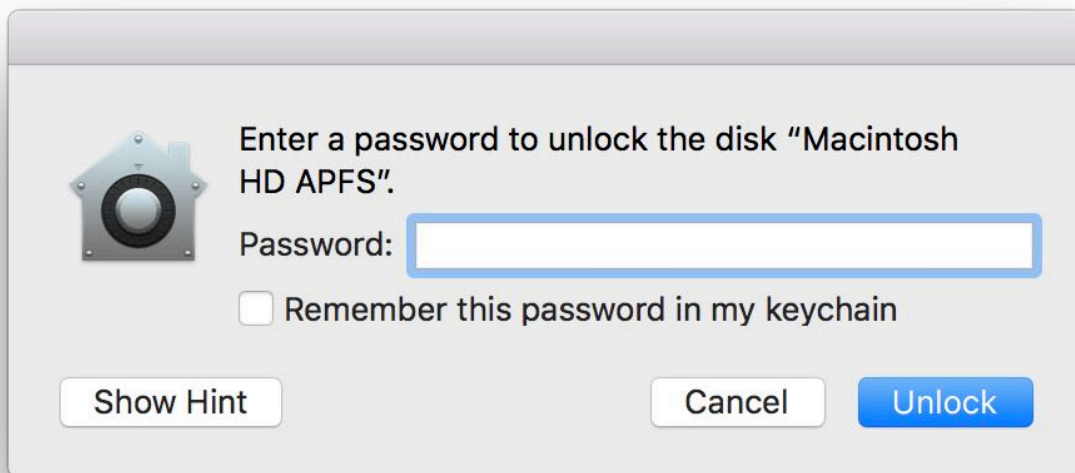
Important: The length of time required to complete this process depends on how much data is on the drive. This process could take up to two days.

12. Transfer complete.

Important: Check the transfer is successful before closing the repair. Once the repair is closed this procedure cannot be performed again on the KBB logic board.



13. Make sure the external drive is encrypted and the password works by unplugging it and plugging it back in.



14. Once the repair is closed, data transfer using this process is no longer possible.

Troubleshooting Tips:

If the Data Transfer Setup suite is unavailable, check the following:

1. Verify that the correct data migration part number has been added to the repair and saved.
2. Verify that the repair that includes the logic board has not been closed.
3. Verify that the correct serial number of the customer's computer was entered into the Diagnostic Console.
4. Verify that the serial number of the customer's computer was used to create the repair.
5. Verify that the device is correctly connected to the host Mac and that Mac Configuration Utility is running.
6. A correctly connected device will show as "Apple Mobile Device (DFU Mode)" in System Information > USB.
7. Do not use USB-C to USB-A cable (923-00504) combined with USB-C to USB Adapter (MJ1M2AM/A).

If the device does not complete the Data Transfer Setup suite, check the following:

1. Archive the AST 2 session, create a new one, and re-run the Data Transfer Setup suite.
2. Restart the host Mac.

If the Data Transfer Utility app does not show any volumes under Select Source Volume(s), check the following:

1. Verify volume(s) appear in Finder or Disk Utility.
2. Verify the correct serial number of the customer's computer was entered into the Data Transfer Utility app.

If the external hard drive is not being recognized by the Data Transfer Utility app, it may need to be initialized using Disk Utility.

Butterfly Mechanism Keycap Replacement

Butterfly Mechanism Keycap Replacement for MacBook Pro (2016 and 2017), MacBook (Retina, 12-inch, 2017), and MacBook Air (Retina, 13-inch, 2018)

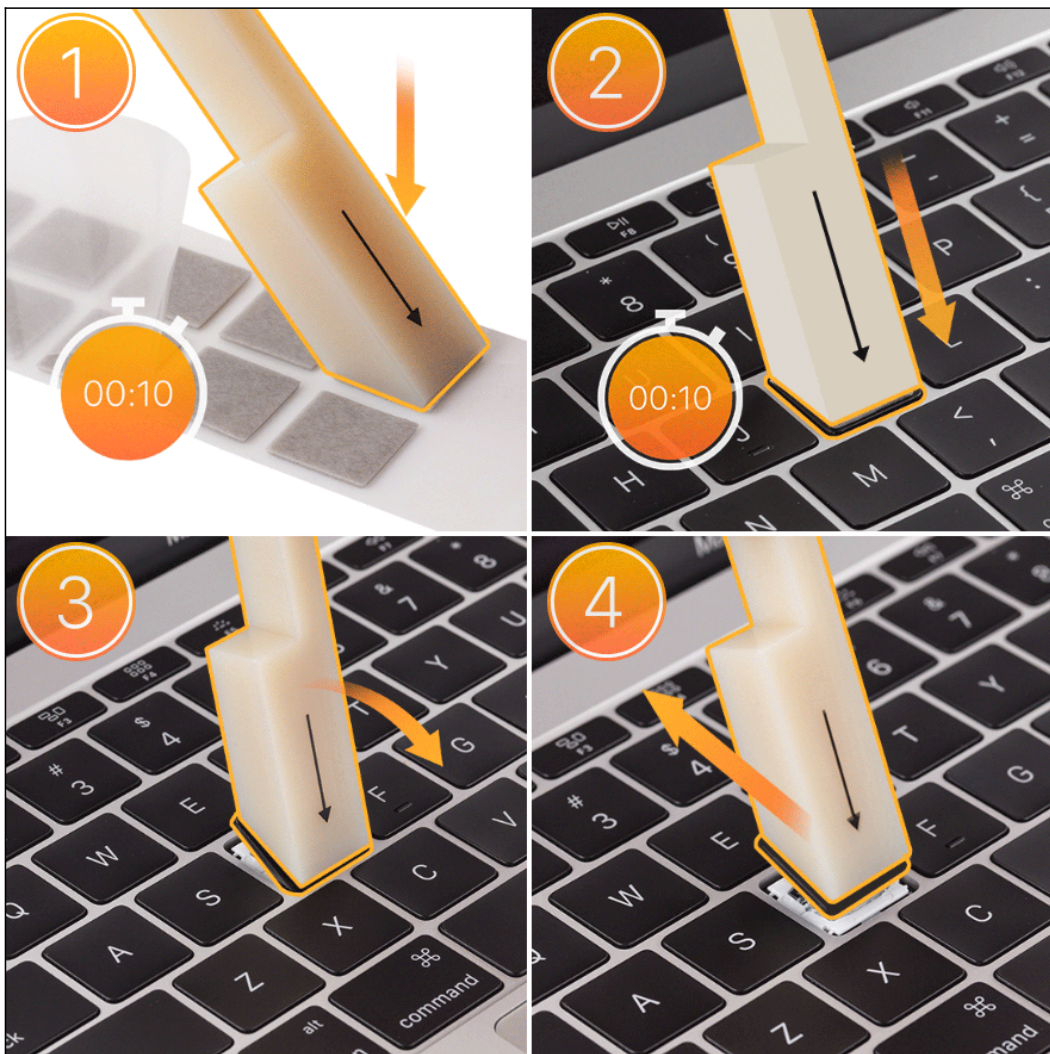
With the introduction of the keycap lever tool, butterfly mechanism keycaps are now easier and faster to replace. Individual keycaps should be replaced instead of the entire top case. This procedure can be done in under three minutes.

This procedure is the quickest and most cost-effective way to fix the following butterfly mechanism issues:

- Sticking keys (stuck in up or down position)
- Key press feels uneven or stiff
- Keycap not responding, is spongy, or is not going all the way down
- The key makes abnormal noise and/or is a metallic click sound
 - **Note:** For MacBook Pro (2016), first install the keycap shim to the new keycap for this issue. Refer to article [TP1550: Keycap Shim Installation](#).

The procedure involves four basic steps:

1. Applying the adhesive to the tool.
2. Pressing the tool on the keycap for 10 seconds.
3. Pulling the keycap in the correct direction to release snaps.
4. Pushing it in the opposite direction to release hooks.



For video instruction, refer to [SV347: Portables Keycap Lever Video](#).

For part numbers, go to the [Keycap Kit Part Numbers](#) section below.

For a guide to placing the lever tool, see the [Keycap Lever Placement Map](#) below.

For detailed information on the procedure, go to the [Procedure for Removing and Replacing Keycaps](#) section below.

Note: If a keycap replacement does not resolve the issue, the entire top case must be replaced. To confirm the correct country code and part number, see article [HT201794: How to identify keyboard localizations](#). Use the exploded view in the service guide to confirm the correct top case part number before ordering a service part.

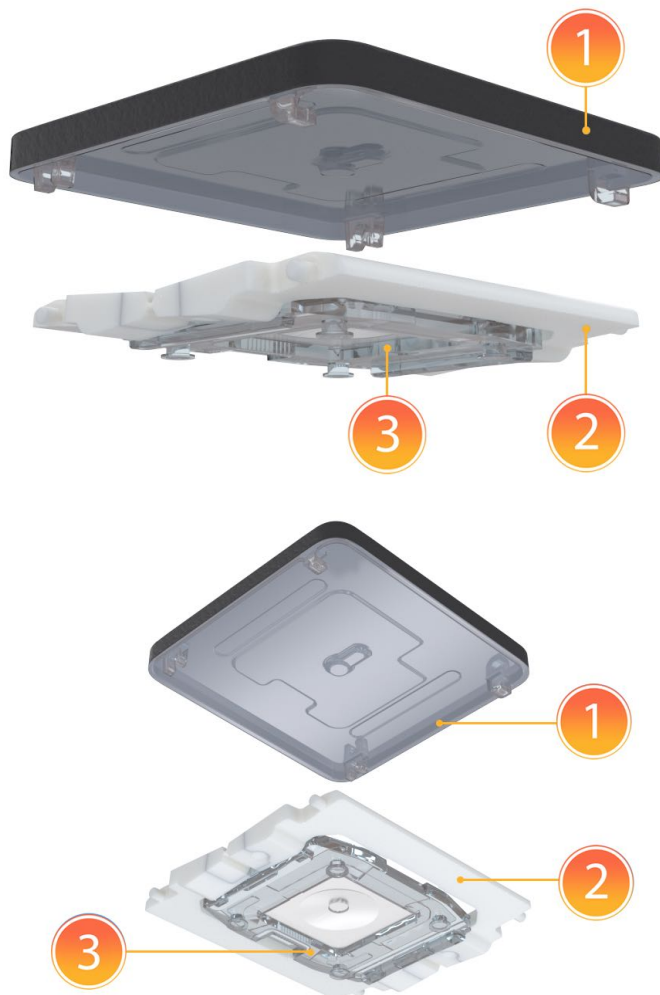
First Steps

- Before replacing the keycap on an unresponsive keyboard, be sure to clean the keyboard thoroughly with compressed air. Then remove the keycap, spray the well with compressed air, and check for liquid damage.
- Always use a new keycap. Do not attempt to reinstall the keycap that was removed.
- For instruction on installing a keycap shim to MacBook Pro (2016) keycaps that exhibit a loud clicking sound after the system has warmed up, refer to article [TP1550: Keycap Shim Installation](#).
- For Arabic keyboards, the return key may show uneven backlighting from top to bottom. This is expected behavior. Do not repair or replace for this issue.
- When replacing an option key, make sure the old option key and the new option key have the same glyphs. If they do not, replace both keys.

1. Keycap Anatomy

Keycap mechanisms consist of three parts. Only number 1 is replaceable:

1. Keycap, the surface key that a user sees on the keyboard
2. Butterfly, the hinged piece under the keycap
3. Switch housing, the piece that secures the butterfly to the top case



Important: Although keycaps can be replaced, the butterfly and switch housing cannot. A damaged switch housing or butterfly requires replacement of the entire top case.

If a keycap needs replacement due to accidental damage, such as a liquid spill, refer to article [OP14: Determining and quoting accidental damage for Mac portables](#).

2. Keycap Kit Part Numbers

Important: The keycap kits vary by the computer color and the keyboard language.

To help determine keyboard localization or keycap placement, refer to article [HT201794: How to identify keyboard localizations](#).

Notes:

- Keycap kits are available for UK English (ISO), U.S. English (ANSI), Chinese (ANSI) and Japanese (JIS) version keyboards.
- The **Super ISO** is a European special character kit that includes specific keycap characters for:
 - German (D)
 - French (F)
 - Danish (DK)
 - Italian (T)
 - Spanish (E)
 - Swedish (S)
- **Common Kits** include:
 - ANSI - space bar, left and right shift, caps lock, delete, tab, return, escape
 - JIS - space bar, return, left and right shift, #1, power
 - ISO - space bar, right shift, caps lock, delete, tab, return, escape

MacBook Pro (13-inch, 2016, 2 Thunderbolt 3 Ports)

Part Number	Label Number	Language	Computer Color
923-01088	605-01344	ANSI English	Space Gray
923-01089	605-01345	ANSI English	Silver
923-01661	605-02130	ANSI English Common Kit	Space Gray
923-01660	605-02129	ANSI English Common Kit	Silver
CH923-01088	CH605-01344	ANSI English, China	Space Gray
CH923-01089	CH605-01345	ANSI English, China	Silver
B923-01088	B605-01344	ISO English	Space Gray
B923-01089	B605-01345	ISO English	Silver
ZM923-01088	ZM605-01344	Super ISO English	Space Gray
ZM923-01089	ZM605-01345	Super ISO English	Silver
ZM923-01661	ZM605-02130	ISO English Common Kit	Space Gray
ZM923-01660	ZM605-02129	ISO English Common Kit	Silver
J923-01088	J605-01344	Japanese	Space Gray
J923-01089	J605-01345	Japanese	Silver
J923-01661	J605-02130	Japanese Common Kit	Space Gray
J923-01660	J605-02129	Japanese Common Kit	Silver

MacBook Pro (13-inch, 2016, 4 Thunderbolt 3 Ports) and MacBook Pro (15-inch, 2016)

Part Number	Label Number	Language	Computer Color
923-01454	605-01811	ANSI English	Space Gray
923-01455	605-01812	ANSI English	Silver
923-01663	605-02132	ANSI English Common Kit	Space Gray
923-01662	605-02131	ANSI English Common Kit	Silver
CH923-01454	CH605-01811	ANSI English, China	Space Gray
CH923-01455	CH605-01812	ANSI English, China	Silver
B923-01454	B605-01811	ISO English	Space Gray
B923-01455	B605-01812	ISO English	Silver
ZM923-01088	ZM605-01344	Super ISO, English	Space Gray
ZM923-01089	ZM605-01345	Super ISO, English	Silver
ZM923-01663	ZM605-02132	ISO English Common Kit	Space Gray
ZM923-01662	ZM605-02131	ISO English Common Kit	Silver
J923-01454	J605-01811	Japanese	Space Gray
J923-01455	J605-01812	Japanese	Silver
J923-01663	J605-02132	Japanese Common Kit	Space Gray
J923-01662	J605-02131	Japanese Common Kit	Silver

MacBook Pro (13-inch, 2017) and MacBook Pro (15-inch, 2017)

Part Number	Label Number	Language	Computer Color
923-01849	605-03030	ANSI English	Space Gray
923-01850	605-03031	ANSI English	Silver
923-01857	605-03034	ANSI English Common Kit	Space Gray
923-01858	605-03035	ANSI English Common Kit	Silver
CH923-01849	CH605-03030	ANSI English, China	Space Gray
CH923-01850	CH605-03031	ANSI English, China	Silver
B923-01849	B605-03030	ISO English	Space Gray
B923-01850	B605-03031	ISO English	Silver
ZM923-01857	ZM605-03034	ISO English Common Kit	Space Gray
ZM923-01858	ZM605-03035	ISO English Common Kit	Silver
J923-01849	J605-03030	Japanese	Space Gray
J923-01850	J605-03031	Japanese	Silver
J923-01857	J605-03034	Japanese Common Kit	Space Gray
J923-01858	J605-03035	Japanese Common Kit	Silver

MacBook (Retina, 12-inch, 2017)

Part Number	Label Number	Language	Computer Color
923-01730	605-02311	ANSI English	Space Gray
923-01731	605-02312	ANSI English	Silver, Gold, Rose Gold
923-01732	605-02313	ANSI English Common Kit	Space Gray
923-01733	605-02314	ANSI English Common Kit	Silver, Gold, Rose Gold
CH923-01730	CH605-02311	ANSI English, China	Space Gray
CH923-01731	CH605-02312	ANSI English, China	Silver, Gold, Rose Gold
B923-01730	B605-02311	ISO English	Space Gray
B923-01731	B605-02312	ISO English	Silver, Gold, Rose Gold
ZM923-01730	ZM605-02311	Super ISO, English	Space Gray
ZM923-01731	ZM605-02312	Super ISO, English	Silver, Gold, Rose Gold
ZM923-01732	ZM605-02313	ISO English Common Kit	Space Gray
ZM923-01733	ZM605-02314	ISO English Common Kit	Silver, Gold, Rose Gold
J923-01730	J605-02311	Japanese	Space Gray
J923-01731	J605-02312	Japanese	Silver, Gold, Rose Gold
J923-01732	J605-02313	Japanese Common Kit	Space Gray
J923-01733	J605-02314	Japanese Common Kit	Silver, Gold, Rose Gold

MacBook Air (Retina, 13-inch, 2018)

Part Number	Label Number	Language	Computer Color
923-03030	605-04763	ANSI English	Space Gray, Silver, Gold
B923-03030	B605-04763	ISO English	Space Gray, Silver, Gold
CH923-03030	CH605-04763	ANSI English China	Space Gray, Silver, Gold
J923-03030	J605-04763	Japanese	Space Gray, Silver, Gold

3. Keycap Lever Placement Map

The following illustrations show where to place the keycap lever when removing keycaps.

Release the edge of the keycap at the snaps before releasing the edge with the hooks. For detailed instructions, go to the [Procedure](#) section below.



Yellow: The hooks are on the bottom and the snaps are on the top.




Blue: The hooks are on the right and the snaps are on the left.





Orange: There are four snaps on top and four hooks on the bottom.



Purple: The hooks are on the left and the snaps are on the right.

 **Green:** There are three hooks on the bottom and three snaps on the top.

 **Light Orange:** There are three hooks on the right and three snaps on the left.

 **Pink (Japan only):** The hooks are on the top and the snaps are on the bottom.

Click on the image below to enlarge it.



4. Procedure for Removing and Replacing Keycaps

Caution:

- Shut down the computer before replacing a keycap.
- Press the keycap lever very gently on the keycap when initializing the VHB. The top case should not bend when pressing the keycap lever tool onto the keycap. Too much pressure can damage the butterfly resulting in a full top case replacement.
- If the butterfly is damaged, a full top case replacement is required.
- Inspect the switch housing with a USB microscope. If the pockets are damaged, a full top case replacement will be required. Refer to step 9 of Section 4A.

Tools:



- Compressed air
- Pre-cut VHB adhesive strips (923-01801, 1x1; 923-01800, 1x.5)
- Keycap lever (923-01803) **Note:** This tool is double-sided. The large side is for yellow, pink, and green keys; the smaller side is for blue, light orange, and purple keys. This tool is not to be used for the space bar (orange keys).
- USB Microscope
- Keycap slider tool
- Keycap tool kit (076-00337) includes: Keycap slider tool, keycap lever, Kapton tape, and pre-cut VHB adhesive strips

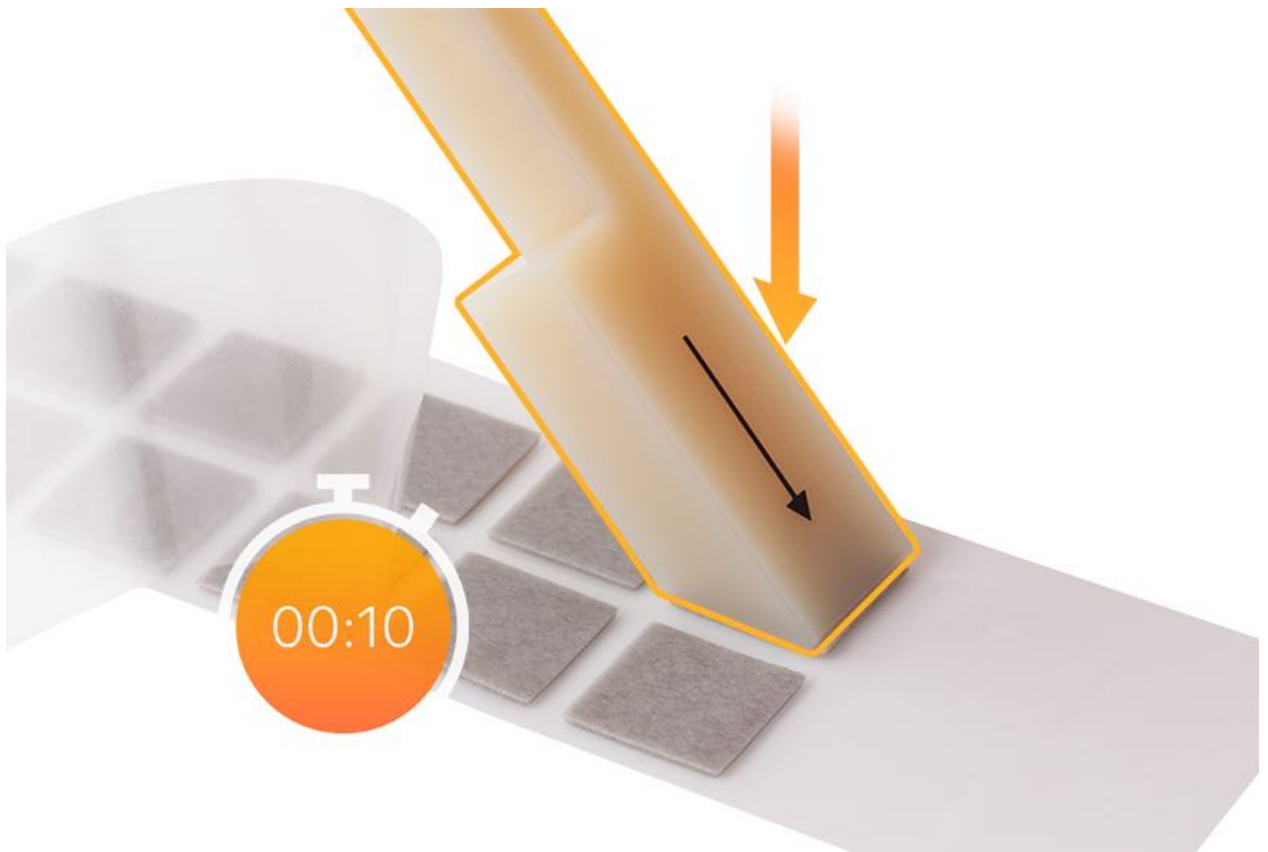
Note: Before attempting this procedure for the first time, practice on a KBB top case and keyboard with butterfly mechanism.

Follow these steps to remove and replace a keycap.

There are four types of keys on the keyboard. Each type requires a different procedure.

A. Removing and Replacing Yellow, Green, and Pink Keys

1. Peel back the frosted paper liner from one side of the adhesive. Press the large end of the keycap lever tool onto the 1x1 adhesive and hold for 10 seconds.



2. Lift the tool, with the adhesive attached, from the clear liner.

3. Lightly press the tool with the adhesive side down, onto the key, aligning the arrow on the tool with the hooks on the keycap. See the keycap map for location of hooks.

Note:

- On the larger keys such as caps lock, return, shift, tab, delete, command, place the tool in the middle of the key.
- If the tool is accidentally placed onto the wrong keycap continue with the removal process and replace with a new keycap. This is necessary due to the strength of the adhesive.



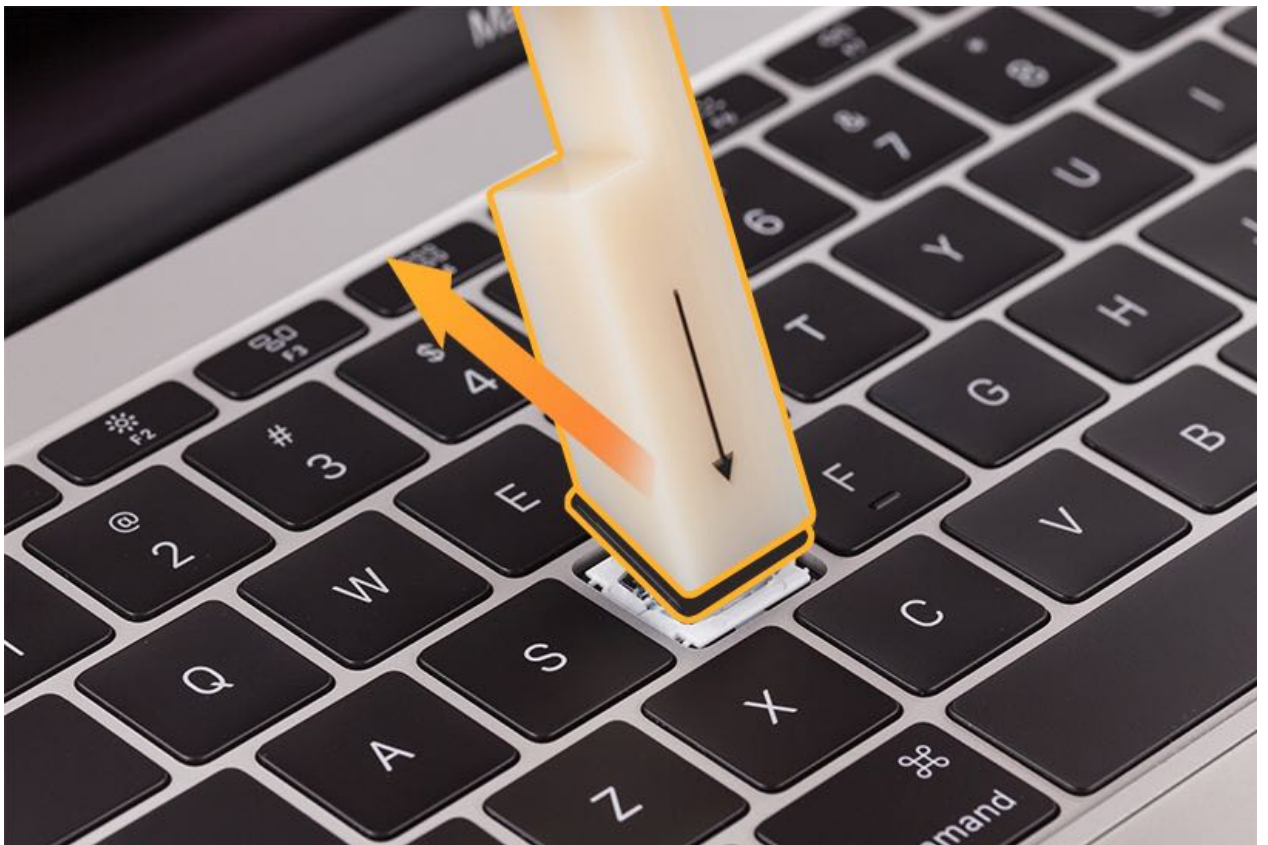
4. Hold for about 10 seconds to activate the adhesive.



5. Slowly pull the lever away from the display to unhook the keycap. Stop when you hear a click.



6. Then push the lever tool up towards the display to unhook the keycap hooks and remove the keycap.



7. Remove the keycap and the adhesive from the keycap lever and discard both. **Note:** The adhesive is one-time use only and needs to be replaced for every keycap removal.

8. Use compressed air to clean the keycap well. **Note:** If the debris is visible and compressed air does not dislodge it, use a black stick to gently dislodge the debris.

9. Visually inspect the butterfly. Be sure the pins are properly seated and have not popped out of place.

10. Using the flat end of a black stick, gently tap the edge of the butterfly on the side of the hinge (circled) and verify that the butterfly moves up and down.



11. If the pins are damaged or not in place or the butterfly does not move up and down, a whole top

case replacement is necessary.

12. Always replace the keycap with a new one. Do not reuse keycaps. Insert the bottom of the keycap into the well at a 15-degree angle and gently push to engage the hooks.

13. Gently push down on the top of the keycap to engage the snaps. If the keycap is not lined up properly, the snaps will not engage. If this happens, start again.

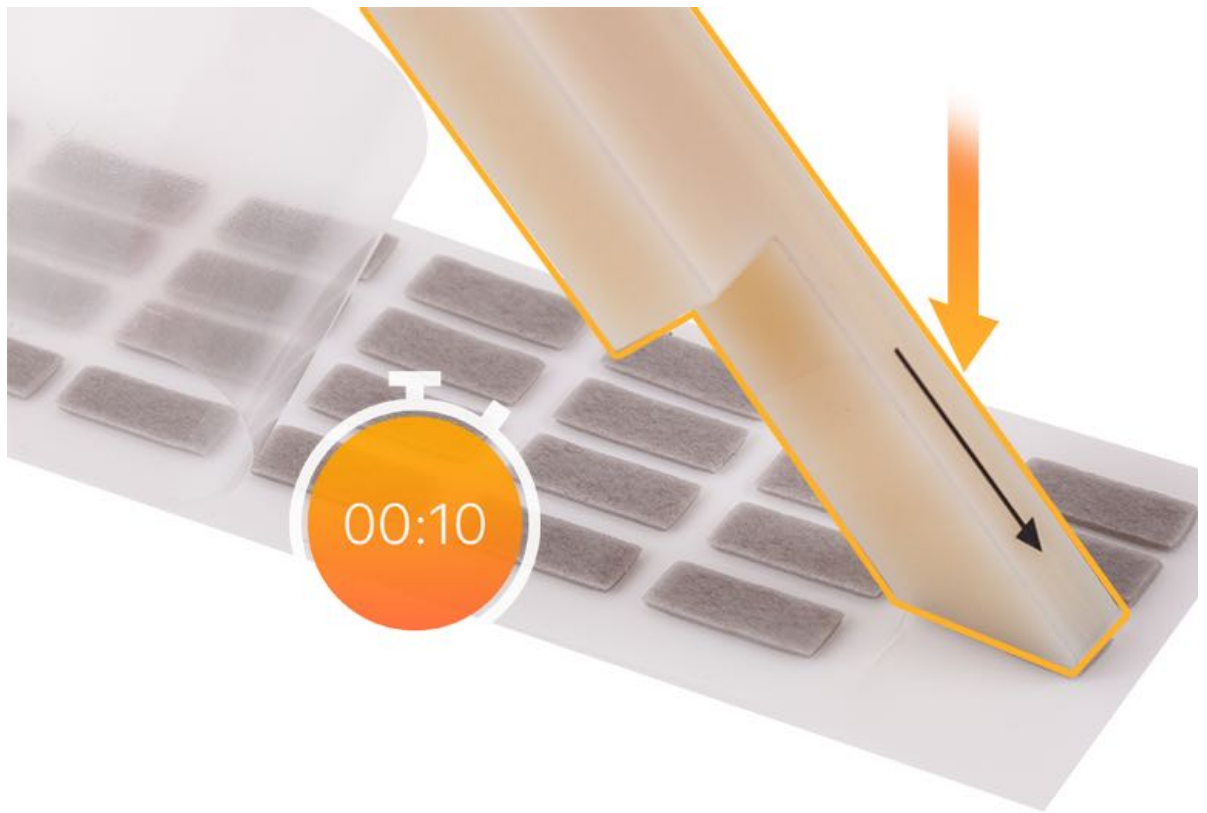
14. Check the key from all angles to make sure it is uniformly flat. Tap the key repeatedly to verify that it springs back each time. Compare the response of the new keycap with the keycaps around it.

15. When replacing the option key, check to make sure both keys have the same glyphs. If the new option key is different from the old one, replace both keys.

B. Removing and Replacing the Up Arrow Keys (Purple), ISO and JIS Return Keys (Light Orange), and the Function and Down Arrow Keys (Blue)

Steps for Removing the Up Arrow Key

1. Peel back the frosted paper liner from one side of the adhesive. Press the small end of the keycap lever tool onto the 1x.5 adhesive and hold for 10 seconds.



2. Lift the tool, with the adhesive attached, from the clear liner.

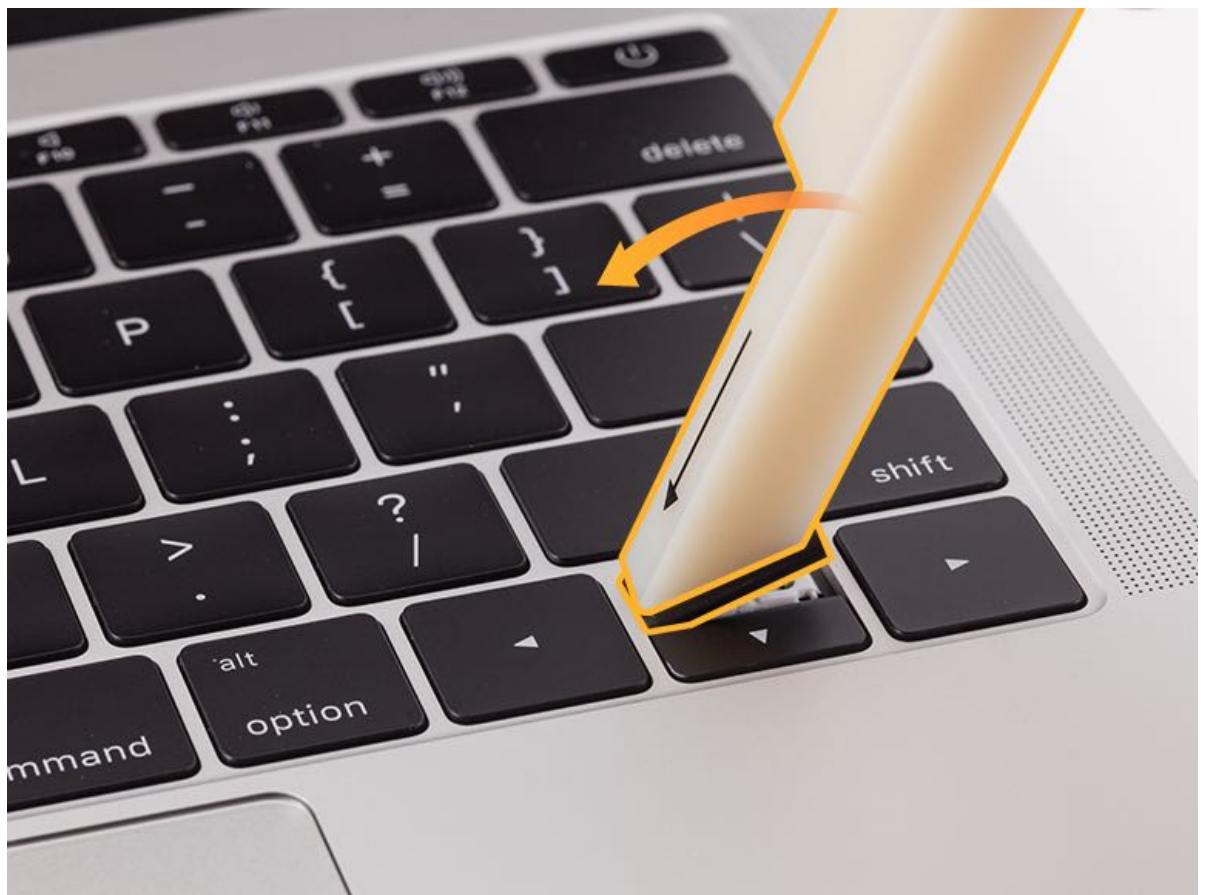
3. Lightly press the tool with the adhesive side down, onto the up arrow key, aligning the arrow with the hooks on the left side.

Note: If the tool is accidentally placed onto the wrong keycap continue with the removal process and replace with a new keycap. This is necessary due to the strength of the adhesive.

4. Hold for about 10 seconds to activate the adhesive.



5. Pull the lever to the left to unsnap the keycap. Stop when you hear a click.



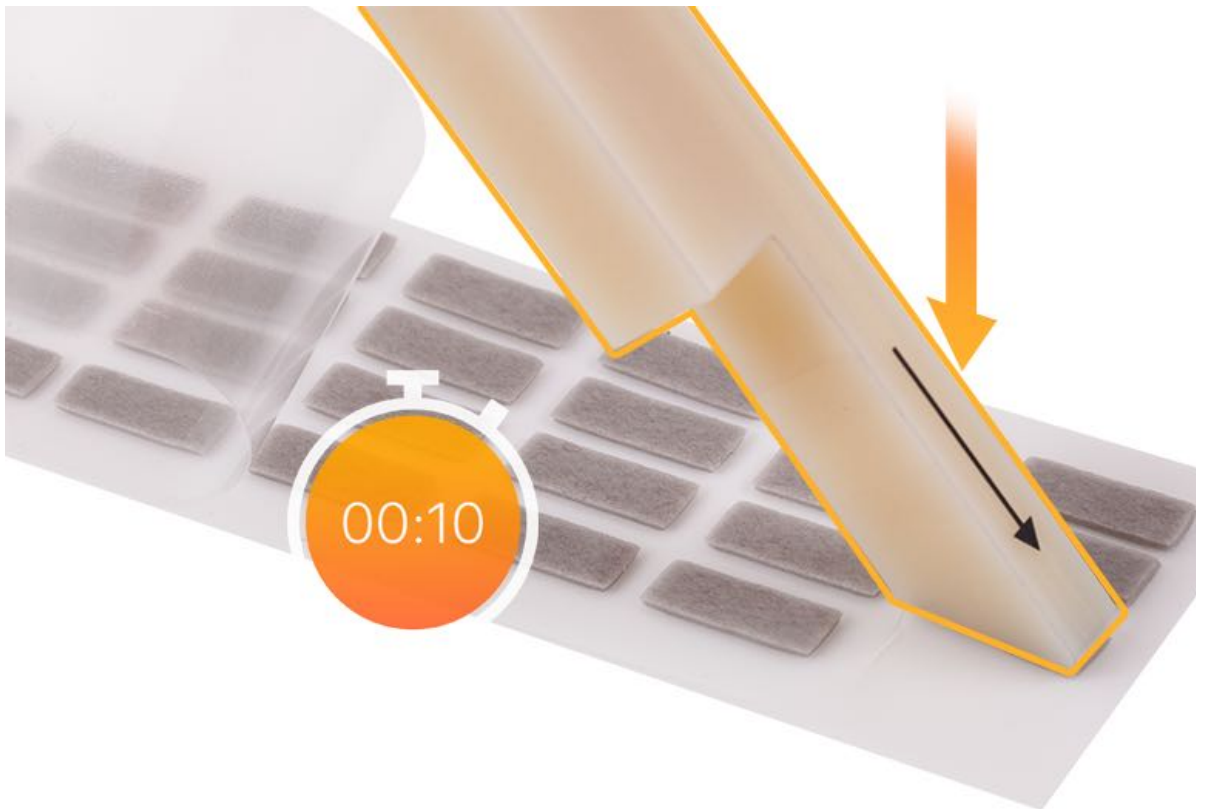
6. Then push the lever slightly forward to unhook the hooks and lift up to remove the keycap.



7. Remove the keycap and the adhesive from the lever and discard both. **Note:** The adhesive is one-time use only and needs to be replaced for every keycap removal.

Steps for Removing the Down Arrow, JIS and ISO Return, and Function Keys

1. Peel back the frosted paper liner from one side of the adhesive. Press the small end of the keycap lever tool onto the 1x.5 adhesive and hold for 10 seconds.



2. Lift the tool, with the adhesive attached, from the clear liner.

3. Lightly press the tool with the adhesive side down, onto the down arrow key or function

key, aligning the arrow with the hooks on the right side.

Note: If the tool is accidentally placed onto the wrong keycap continue with the removal process and replace with a new keycap. This is necessary due to the strength of the adhesive.

4. Hold for about 10 seconds to activate the adhesive.



5. Slowly pull the lever to the right to unsnap the keycap. Stop when you hear a click.



6. Then push the lever slightly forward to unhook the hooks and lift up to remove the keycap.



7. Remove the keycap and the adhesive from the lever and discard both. **Note:** The adhesive is one-time use only and needs to be replaced for every keycap removal.

Replacing the Arrow Keys, JIS and ANSI Return Keys, and Function Keys

1. Visually inspect the butterfly. Be sure the pins are properly seated and have not popped out of place.
2. Using the flat end of a black stick, gently tap the edge of the butterfly on the side of the hinge (circled) and verify that the butterfly moves up and down.



3. If the pins are damaged or not in place or the butterfly does not move up and down, a whole top case replacement is necessary.

4. Always replace the keycap with a new one. Do not reuse keycaps.

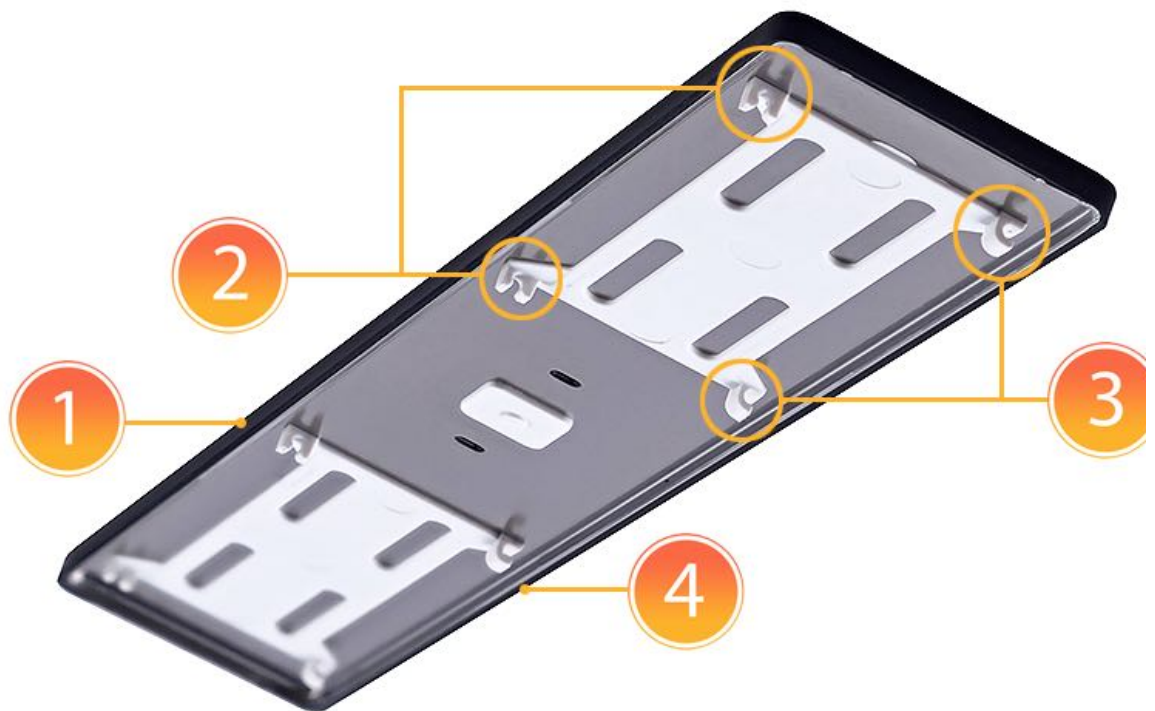
- For the up arrow, insert the right side of the keycap into the well at a 15-degree angle and gently push to engage the hooks.
- For the down arrow and function keys, insert the left side of the keycap into the well at a 15-degree angle and gently push to engage the hooks.

5. Gently push down on the left side of the keycap to engage the snaps. If the keycap is not lined up properly, the snaps will not engage. If this happens, start again.

6. Check the key from all angles to make sure it is uniformly flat. Tap the key repeatedly to verify that it springs back each time. Compare the response of the new keycap with the keycaps around it.

C. Removing and Replacing the Space Bar Key (Orange)

1. Display side (top of Space bar)
2. Snap
3. Hook
4. Trackpad side (bottom of Space bar)



Note: The Space bar key has four hooks near the bottom edge and four snaps near the top edge. All four snaps and hooks must be released to remove the Space bar. Do not lift from the middle of the key.

1. Insert the tool in the middle of either side of the Space bar between the keycap and the top case. Be sure the tool is vertical and fully inserted.



2. Grip the tool close to the bottom tip. Angle the tool and slide out so just the tip of the tool catches the edge of the keycap. **Caution:** If the tool is bending, too much pressure is being applied or the procedure is not being done correctly. Start again at Step 1.



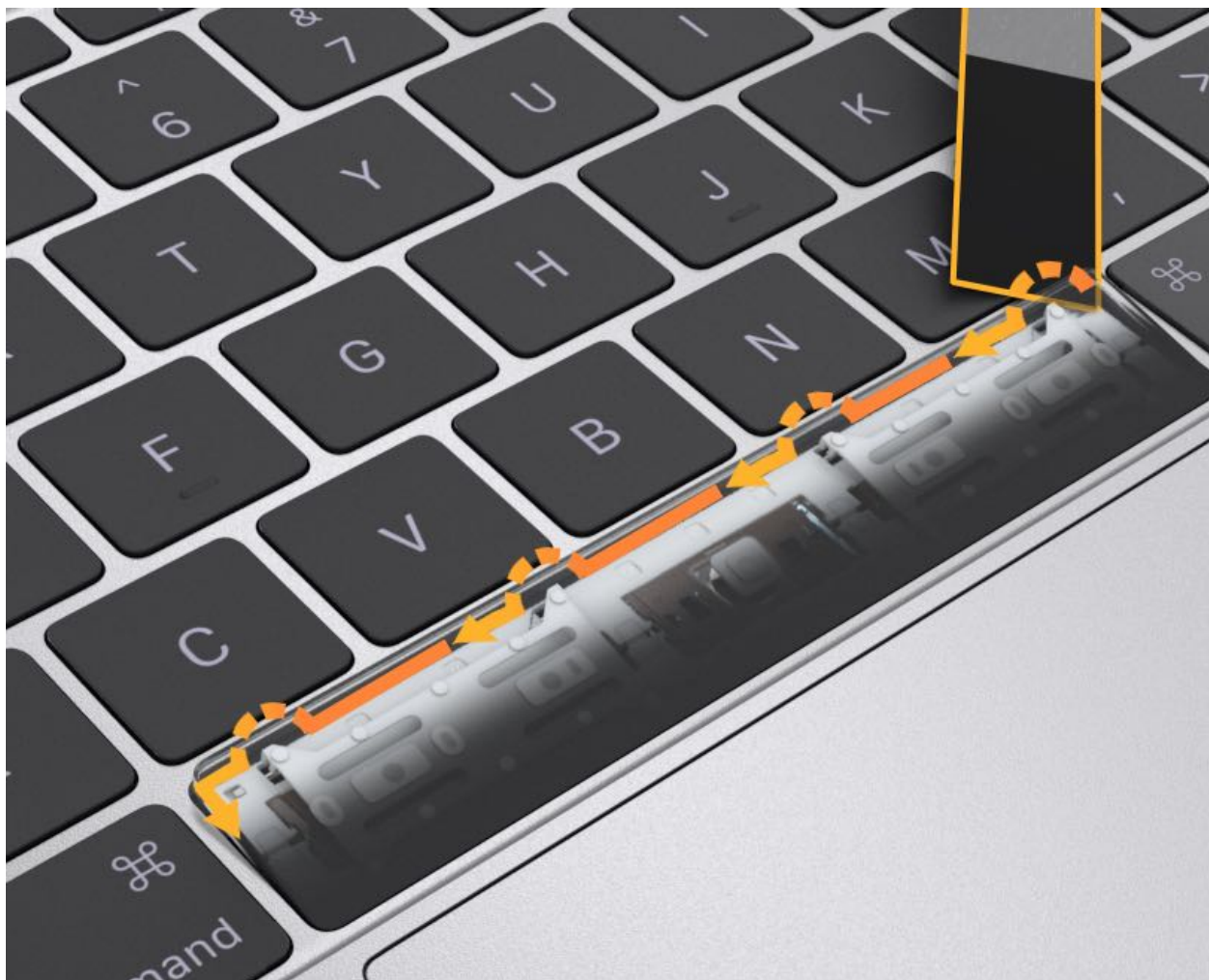
3. Fully slide the tool back so that it is in between the keycap and the butterfly. The tool should be nearly parallel to the top case. You should feel the tool engage between the keycap and the butterfly. If you do not feel the tool engage, start over at Step 1.



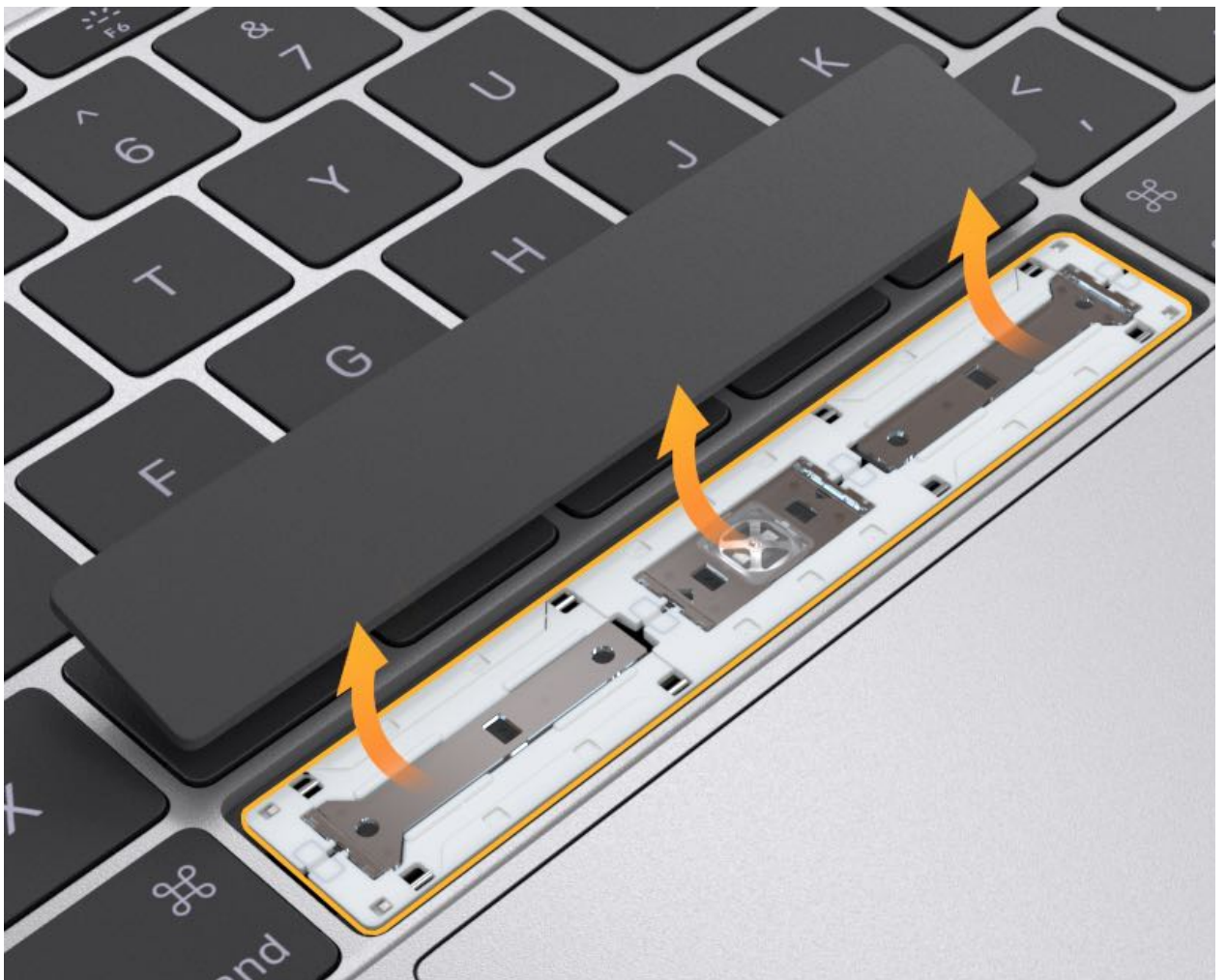
4. Gently slide the tool up toward the top of the key. The tool should be nearly parallel to the top case. As you slide the tool, you should feel the first snap disengage. If you do not feel the snap disengage, remove the tool and begin again at Step 1. **Note:** Do not pry the keycap off or twist the tool, the sliding motion is enough to disengage the snaps.



5. Slowly slide the tool up and around the snaps, moving from top corner to top corner of the Space bar. Listen for the click or pop of the snaps being disengaged. **Note:** If the tool slips out from between the keycap and the butterfly, gently lift the side of the Space bar that you have already disengaged and reinsert the tool between the keycap and the butterfly.



6. Tilt the Space bar about 30 degrees toward the trackpad and feel the bottom hooks disconnect from the butterfly. Slide the keycap out toward the display.

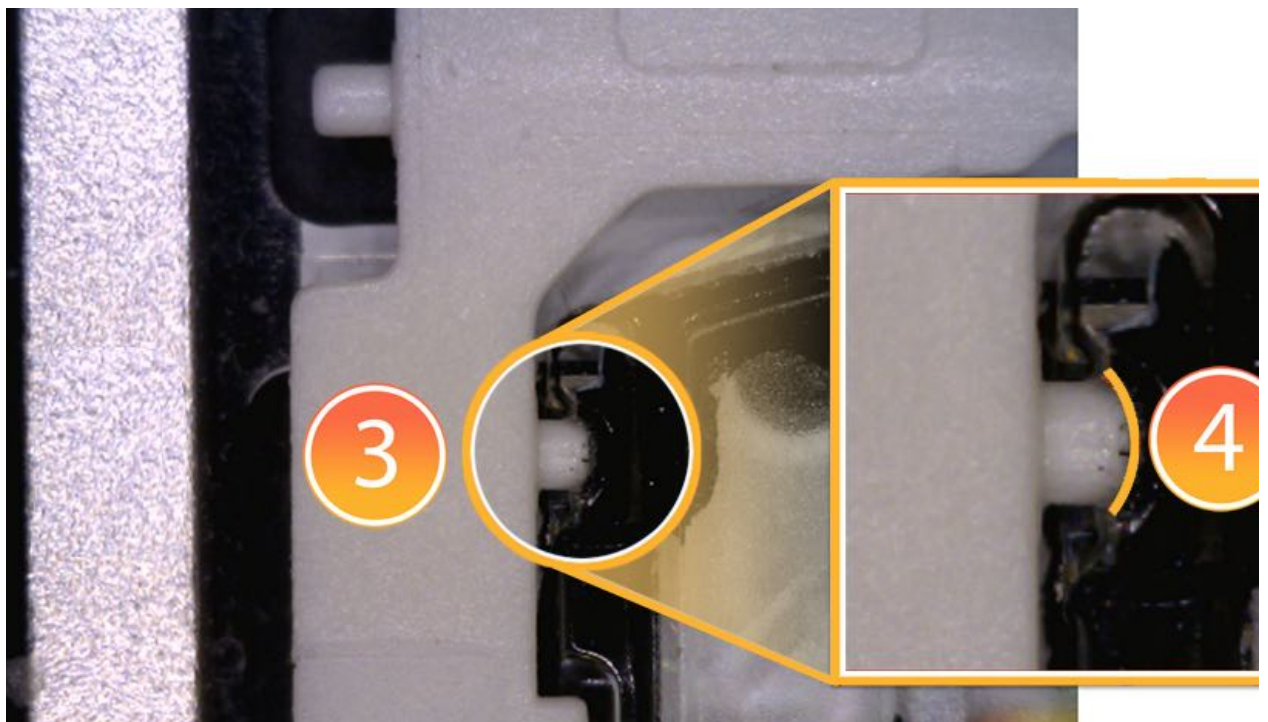
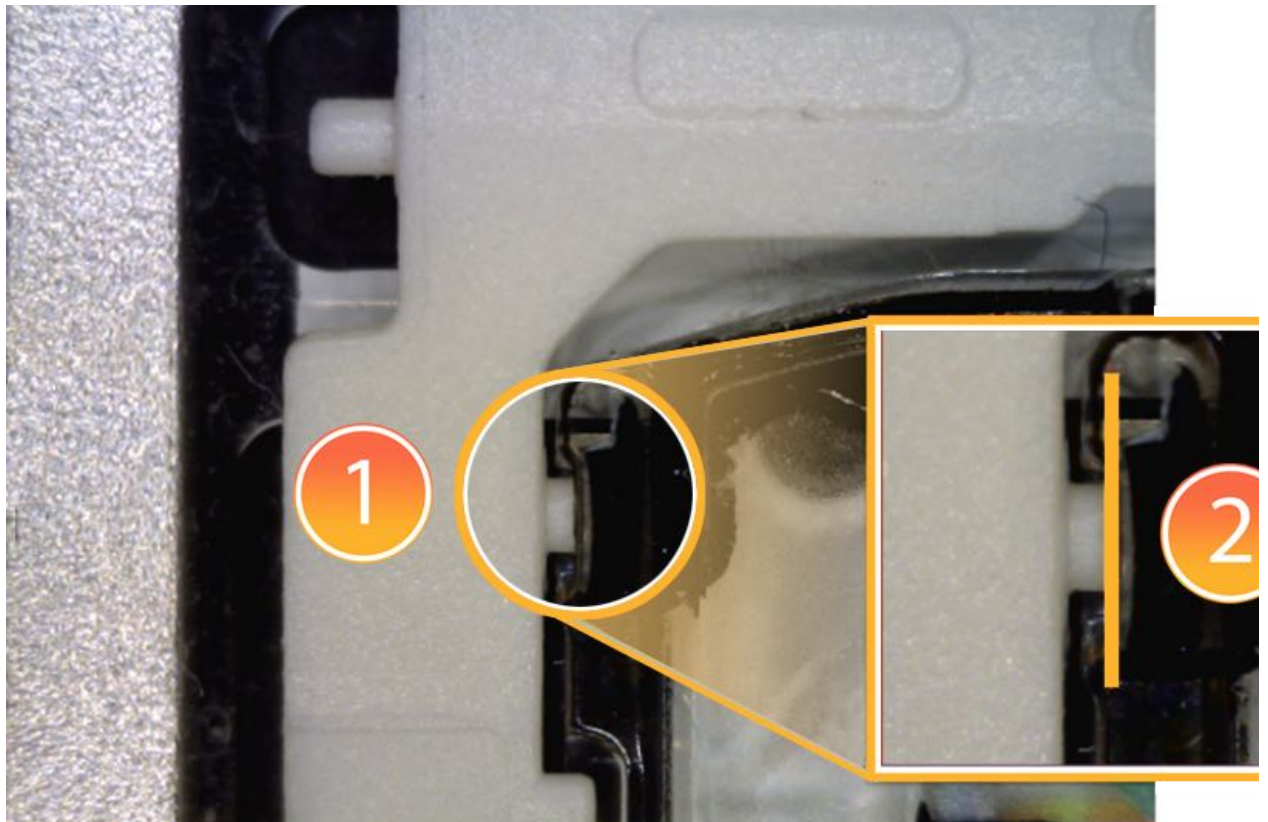


7. Use compressed air to clean the well. **Note:** If the debris is visible and compressed air does not

dislodge it, use a clean cloth to gently dislodge the debris.

8. Visually inspect the butterfly. Be sure the pins are properly seated and have not popped out of place.

1. Good switch housing pocket
2. Good clean edge shows that pin is covered
3. Broken switch housing pocket: replace top case
4. Damaged edge that shows pin uncovered: replace top case



9. Using the flat end of a black stick, gently tap the edge of the butterfly on the side of the hinge (circled) and verify that the butterfly moves up and down.



10. If the pins are damaged or not in place or the butterfly does not move up and down, a whole top case replacement is necessary.

11. Always replace the keycap with a new one. Do not reuse keycaps. Insert the bottom of the keycap into the well at a 15-degree angle and gently push to engage the hooks.

12. Gently push down on the top of the keycap and run your finger across the top of the Space bar to engage all four of the snaps. **Note:** If the keycap is not lined up properly, the snaps will not engage. If this happens, start again.

13. Check the key from all angles to make sure it is uniformly flat. Tap the key repeatedly to verify that it springs back each time. Compare the response of the new keycap with the keycaps around it.

Visual/Mechanical Inspection (VMI) Guide for Mac Computers - Table of Contents

Visual/Mechanical Inspection (VMI) Guide for Mac Computers - Table of Contents

- [Mac Displays](#)
- [Liquid Damage](#)
- [Power Adapters](#)
- [USB-C Cables](#)

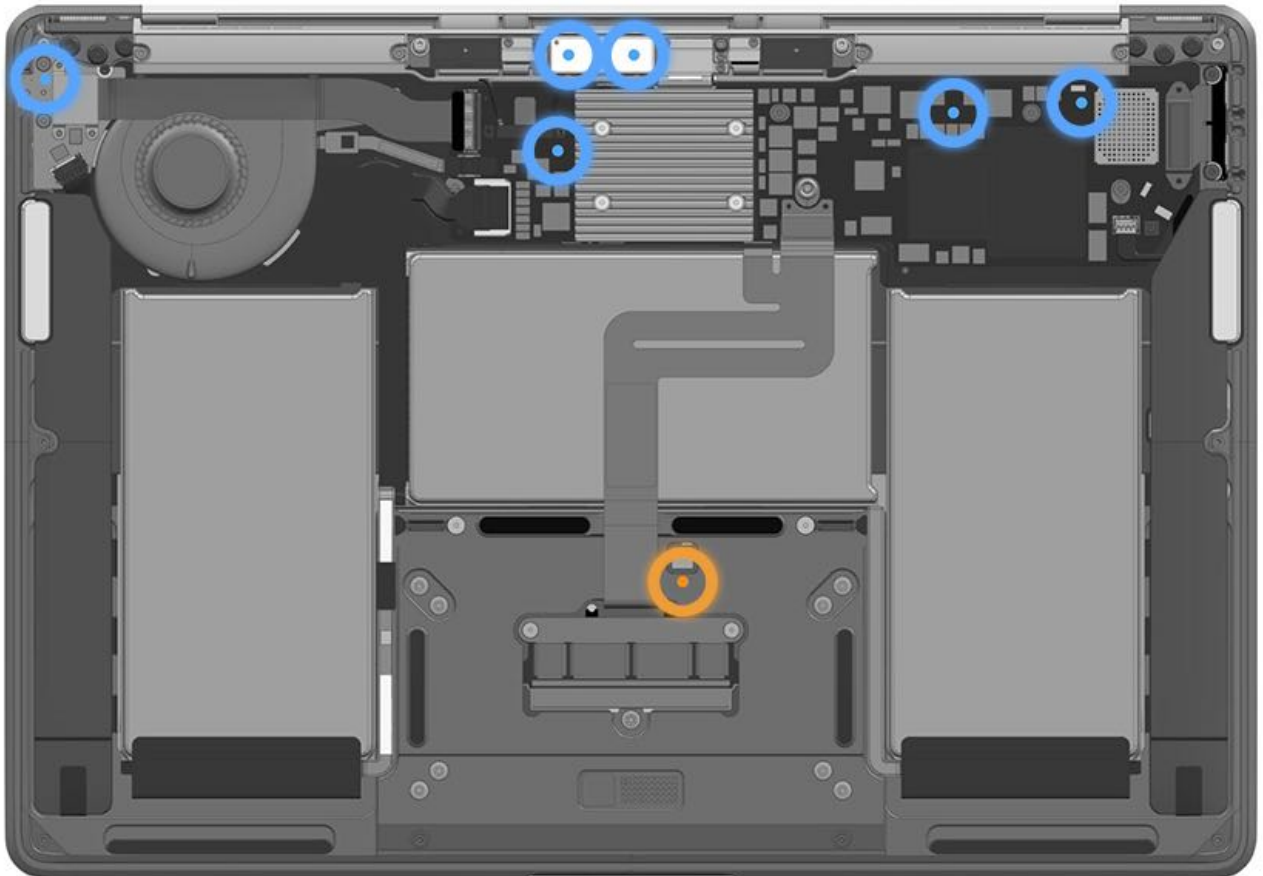
Liquid Contact Indicators

Liquid Contact Indicators for MacBook Air (Retina, 13-inch, 2018)

The top case includes spill sensors called liquid contact indicators (LCIs) to help discover accidental damage to the computer. The sensors are visible only when the bottom case and most of the modules have been removed. The LCIs turn red when they have come in contact with liquid, such as an accidental spill.

For more information, refer to article [HT204769: Mac computers: About liquid contact indicators \(LCIs\) and warranty coverage](#).

- Blue = Black Ultraviolet (UV) LCI
- Orange = White Non-UV LCI



For more information on UV LCIs, refer to [TP1557: How to Read Liquid Contact Indicators with Ultraviolet \(UV\) Light](#).

How to Read Liquid Contact Indicators with Ultraviolet (UV) Light

How to Read Liquid Contact Indicators with Ultraviolet (UV) Light

MacBook (Retina, 12-inch, 2017), MacBook Air (Retina, 13-inch, 2018), and MacBook Pro (2018) contain spill sensors called liquid contact indicators (LCIs). LCIs help discover accidental damage to the computer. They are black, and liquid contact is only visible with the use of a UV light. LCIs appear black under normal light and glow blue when highlighted with a UV light. They turn pink or produce a pink halo when they come in contact with liquid.

Note: MacBook Pro (15-inch, 2018) also has one LCI that appears white and turns pink when it comes in contact with liquid. Refer to [TP1660: Liquid Contact Indicators](#).

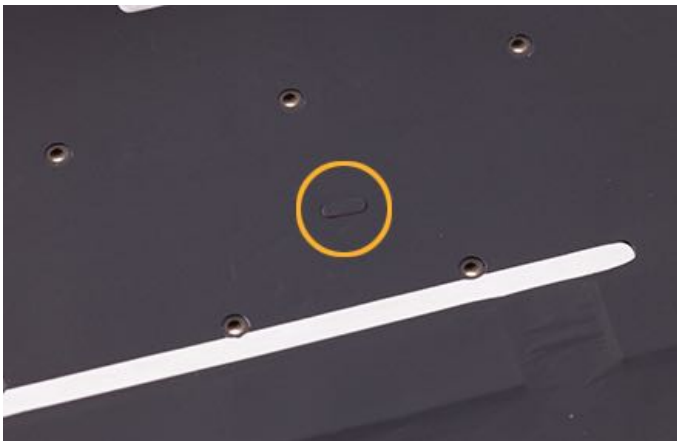
For more information, refer to [HT204769: About liquid contact indicators \(LCIs\) and warranty coverage](#).

For video instruction, refer to [SV348: Using UV Light to Read LCIs Video](#).

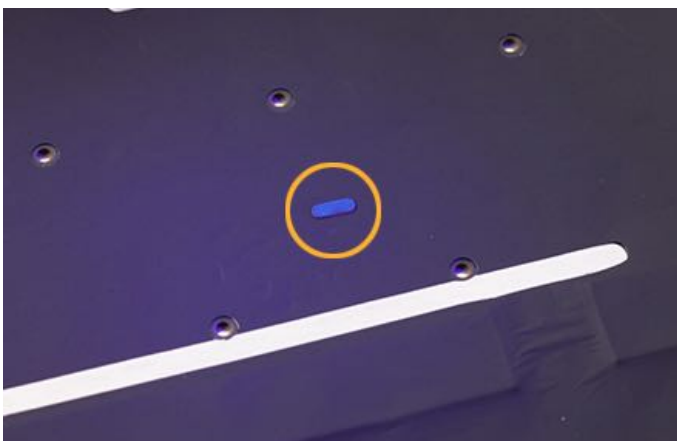
Important: A triggered LCI is not the only evidence of liquid contact. Be sure to inspect for corrosion or liquid residue during a quick check or repair. Refer to [TP1150: Visual/Mechanical Inspection \(VMI\) Guide for Mac Liquid Damage](#) for instructions on how to inspect for liquid damage.

No Liquid Contact:

- LCI without UV light

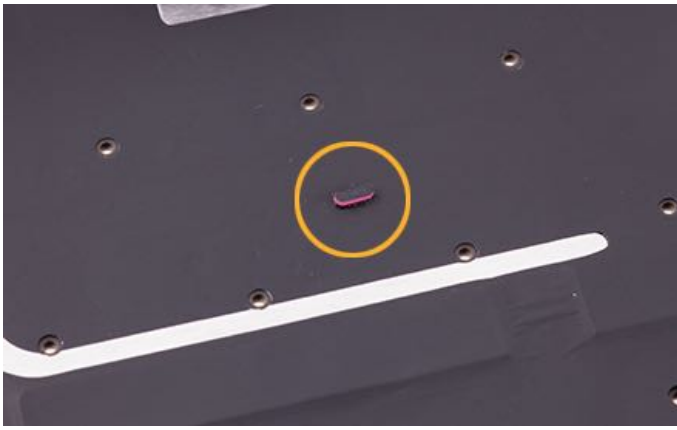


- LCI with UV light

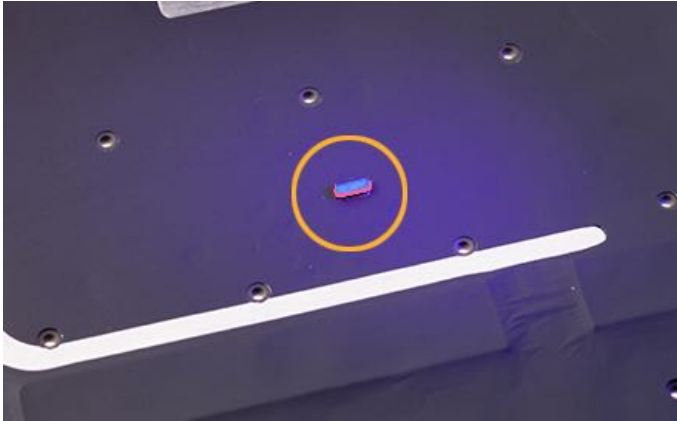


Liquid Contact:

- LCI without UV light



- LCI with UV light



Safety Information:

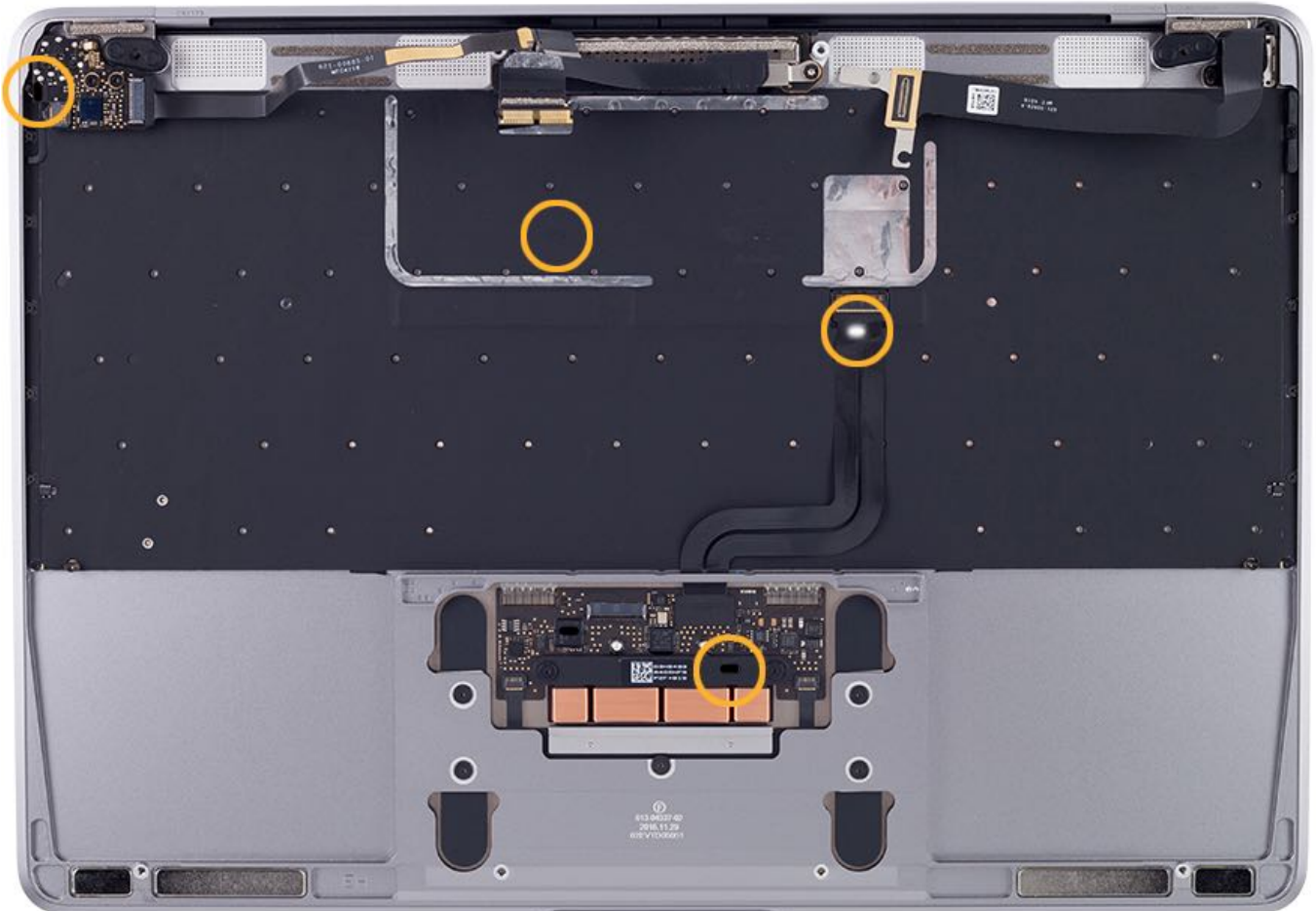
Caution: UV LCIs illuminate with the use of the Apple-approved UV light (923-01604). Follow safety precautions when using this tool:

- Do not remove the warning labels on the UV light.



- Do not shine the UV light in anyone's eyes or face.
- Avoid repeated exposure to the UV light.
- If a different UV light is used, safety glasses and gloves must be worn to avoid excessive exposure.

The following images show the general location of LCIs in a MacBook computer.



For the location of LCIs in MacBook Air (Retina, 13-inch, 2018) and MacBook Pro (2018) models, refer to the following articles:

- [TP1691: MacBook Air \(Retina, 13-inch, 2018\): Liquid Contact Indicators](#)

- [TP1661: MacBook Pro \(13-inch, Four Thunderbolt 3 Ports, 2018\): Liquid Contact Indicators](#)
- [TP1660: MacBook Pro \(15-inch, 2018\): Liquid Contact Indicators](#)

Procedure

Note:

- Ultraviolet LCIs are black. The black LCIs blend in with the rest of the computer. When in contact with liquid, the LCIs may swell and become easier to identify.
- When using the UV light, hold it 12 to 14 inches (30 to 35 centimeters) from the computer and shine it at an angle of 15 to 75 degrees.
- **Warning:** While the UV light is shining, do not hold it close to your face or bend your head down to look closely at the LCIs.



1. Press the power button on the UV light.



2. Check the color of the LCI. Blue indicates an LCI that has not been triggered. A pink LCI or a pink halo around the LCI indicates that it has been triggered. Refer to visual examples at the top of this article.

LCD Pixel Anomalies

When displaying a single color over the screen area, the liquid crystal display (LCD) might show one or more pixels that are not properly lit.

LCD technology uses rows and columns of addressable points (pixels) that render text and images on the screen. Each pixel has three separate subpixels (red, green, and blue) that allow an image to render in full color. Each subpixel has a corresponding transistor responsible for turning the subpixel on and off.

Depending on the display size, there can be thousands or millions of subpixels on an LCD. For example, the LCD used in iMac (27-inch, Late 2013) has a display resolution of 2560 by 1440, which means there are 3.7 million pixels. Each pixel is made up of a red, a green, and a blue subpixel, resulting in over 11 million individual picture elements on the 27-inch display. Occasionally, a transistor may not work perfectly, resulting in the affected subpixel remaining off (dark) or on (bright). With the millions of subpixels on a display, it is possible to have a low number of such transistors on an LCD. In some cases, a small piece of dust or other foreign material may appear to be a pixel anomaly. Apple strives to use the highest-quality LCD displays in its products, but pixel anomalies can occur in a small percentage of them.

In some cases, pixel anomalies are caused by a piece of foreign material that is trapped inside the display or on the surface of the display or glass panel. Foreign material is typically irregular in shape and is usually most noticeable when viewed against a white background.

- For any computer, foreign material on the surface of the display or glass panel can easily be removed using a lint-free cloth.
- For iMac only, foreign material trapped between the glass panel and display should be removed by an Apple Authorized Service Provider or at an Apple Store.
- For any computer, foreign material trapped inside the display can only be resolved by replacing the entire display assembly.

To determine if the display has an acceptable number of pixel anomalies, see the appropriate article:

- [HT202025: About LCD display pixel anomalies for Apple products released in 2010 and later](#)
- [HT201613: About LCD display pixel anomalies for Apple products released before 2010](#)

General Troubleshooting

Update Software and Firmware

Important: Before troubleshooting, ensure the correct version of macOS is installed, and check for and apply the latest software and firmware updates. Computers sometimes exhibit symptoms that indicate the incorrect version of macOS is installed. Refer to [HT201686: Use the Mac operating system that came with your Mac, or a compatible newer version](#) to make sure system build is correct for this computer model.

Firmware refers to software that is written into memory circuits such as flash memory, which will hold the software code indefinitely, even when power is removed from the hardware. Firmware on Intel-based Mac computers prior to computers with an Apple T2 Security Chip is designed to be updated if necessary by running macOS Software Update (available in the Apple () menu under About This Mac) while the computer is connected to the Internet.

For computers with an Apple T2 Security Chip, SMC and EFI separate firmware images have now both been integrated into bridgeOS.

Troubleshooting Techniques

For more information, go to [ATLAS](#) and enter “troubleshooting” in the search field.

Hardware versus Software

To isolate a hardware issue from a software issue, refer to [HT203161: Isolating issues in macOS](#).

To troubleshoot a software issue, refer to the following articles:

- [HT201516: How to troubleshoot a software issue](#)
- [HT201861: About incompatible software on your Mac](#)
- [HT204323: If a flashing question mark appears when you start your Mac](#)
- [HT204904: How to reinstall macOS from macOS Recovery](#)
- [HT202574: About Fusion Drive, a storage option for some Mac computers](#)

Quick Check Procedures

System Configuration for Macs with the Apple T2 Security Chip

Important: For Macs with the Apple T2 Security Chip, the repair process is not complete for certain parts replacements until the AST 2 System Configuration suite has been run. Failure to perform this step will result in an inoperative system and an incomplete repair.

- [TP1657: System Configuration for Macs with the Apple T2 Security Chip](#)
 - For MacBook Pro (2018): Display assembly, logic board, top case, and Touch ID board
 - For MacBook Air (Retina, 13-inch, 2018): Logic board and Touch ID board
 - For iMac Pro: Logic board and flash storage
 - For Mac mini (2018): Logic board

Resetting the System Management Controller (SMC)

The System Management Controller (SMC) is a chip on the logic board that controls all power functions. On some Mac computers, the Apple T2 Security Chip integrates several controllers—such as the SMC, image signal processor, audio controller, and SSD controller. If the computer is experiencing any power issue, such as not starting up, not displaying video, sleep issues, or fan noise issues, resetting the SMC may resolve it.

For more information and instructions to reset the SMC on different computer models, refer to [HT201295: How to reset the System Management Controller \(SMC\) on your Mac](#).

Note for iMac: If the power button is pressed while the power cord is being inserted, the iMac will enter a mode that runs the fans at full speed. For more information, refer to [HT204463: iMac: Fans run at full speed after computer turns on](#).

Note for iMac Pro (2017): If the power button is pressed while the power cord is being inserted, the iMac will enter Device Firmware Upgrade (DFU) mode and will need to be restored.

Resetting Nonvolatile RAM (NVRAM)

NVRAM stores certain system and device settings in a location that macOS can access quickly. Exactly which settings are stored in the computer's NVRAM varies depending on the type of computer, connected devices, and drives. To reset NVRAM:

For information, refer to [HT204063: How to Reset NVRAM or PRAM on your Mac](#).

Starting Up in Safe Mode

Safe mode (sometimes called safe boot) is a way to start up a Mac so that it performs certain checks and prevents some software from automatically loading or opening. These changes can help resolve or isolate certain issues on the startup disk.

For information, refer to [HT201262: Use safe mode to isolate issues with your Mac](#).

Recovering a Lost Firmware Password

Only technicians at Apple Stores or Apple Authorized Service Providers can unlock the following Mac models when they are protected by a firmware password:

- iMac (Mid 2011) and later
- iMac Pro (2017)
- MacBook (Retina, 12-inch, Early 2015) and later
- MacBook Air (Late 2010) and later
- MacBook Pro (Early 2011) and later
- Mac mini (Mid 2011) and later
- Mac Pro (Late 2013)

Refer to the technician instructions in [HT204455: How to set a firmware password on your Mac](#).

Sleep Status Tips

Sleep Status Tips for MacBook (Retina, 12-inch, Early 2015 and later) and MacBook Pro (2016 and later)

These computer models do not have a sleep indicator light. To troubleshoot without one:

- Press and hold the Caps Lock key to wake the computer from sleep. The Caps Lock indicator light is a good indication of power.
- Check the haptic response of the trackpad. The trackpad will not have any haptic response when there is no power to the system, except for 2018 models which will show a response even with no power.
- Open the display and press an alphanumeric key to wake the computer from sleep.
- A computer that has been in sleep mode for an extended period can consume the remaining battery charge. Restore power to the computer with a known-good power adapter. The computer will start up from a hibernation file and start up from where it left off.
- Use a USB-C to USB Adapter, USB-C Digital AV Multiport Adapter, or USB-C VGA Multiport Adapter to connect a USB device that has a power-on or activity indicator light. As power is restored to the USB and the computer wakes from sleep, the indicator light illuminates.

Note: A USB-C to USB adapter may be used if power does not need to be supplied to the computer.

- Resetting the System Management Controller (SMC) instantly shuts down the computer, with some side effects:
 - If the computer is in sleep mode, it will start up from a hibernation file.
 - If the computer is running OS X or macOS during the SMC reset, data from open applications can be lost.
 - If the computer is already shutdown, there will be no side effects.

MacBook Pro (13-inch, 2018, Four Thunderbolt 3 Ports), MacBook Pro (15-inch, 2018), and MacBook Air (Retina, 13-inch, 2018)

The troubleshooting steps listed above still apply for these computer models. Pressing any key or the trackpad, connecting to a power adapter, and opening the display will also start these computer models. Note the following behaviors when the computer is shutdown and the battery has some remaining charge:

- The Caps Lock indicator light may illuminate when pressed.
- The trackpad will provide a haptic response when pressed.
- The computer will start up when the display is opened.
- The computer will start up when the display is open and it is connected to a power adapter.

For more information, refer to [HT201150: How to turn your Mac on or off](#).

Diagnostic Software

Apple Service Toolkit 2 (AST 2)

AST 2 is a cloud-based diagnostic system that helps technicians triage and verify repairs for iOS devices and Mac computers released in June 2014 and later, except for MacBook Pro (Retina, Mid 2014). Technicians use AST 2 to initiate diagnostics wirelessly on a user's device using the Diagnostic Console (a web application on a Mac or iPad). Technicians can also view diagnostic results on the Diagnostic Console.

For computers with the Apple T2 Security Chip, System Configuration (found in AST 2) must be run after certain repairs for the repair to be complete. Failure to do so will result in an inoperative system and an incomplete repair. Refer to [TP1657: System Configuration for Macs with the Apple T2 Security Chip](#) for more information.

For more information, refer to the following articles:

- [OP476: Latest Apple Service Toolkit download links and documentation](#)
- [TP1105: AST 2 for Mac Reference Guide - Table of Contents](#)
- [TP1118: AST 2 for Mac Reference Guide - Table of Contents \(Retail\)](#)

Apple Diagnostics

Apple Diagnostics is a customer-facing software tool that is built into all Mac computers released in June 2013 and later.

For more information, refer to the following articles:

- [HT202731: How to use Apple Diagnostics on your Mac](#)
- [HT203747: Apple Diagnostics: Reference codes](#)

Thermal and Electrical Sensors

Reference the tables below for sensor information:

- Thermal Sensor Table for MacBook Air (Retina, 13-inch, 2018)
- Electrical Sensor Table for MacBook Air (Retina, 13-inch, 2018)

Thermal Sensor Table for MacBook Air (Retina, 13-inch, 2018)

SMC Name	Location	General Description (Degrees C)	Diagnosis
TB0T	Battery	Battery temperature	Excessive battery temperature, open/damaged BMU or logic board contacts.
TB1T	On BMU	Battery TS1	Excessive battery temperature, open/damaged BMU or logic board contacts.
TB2T	Near battery cell	Battery TS2	Excessive battery temperature, open/damaged BMU or logic board contacts.
TC0P	Logic board, top side, right	CPU proximity temperature	Excessive temperature on the logic board near the CPU IC.
TCaP	Logic board top side, center	SMC proximity temperature	Excessive temperature on the logic board.
TCHP	Logic board, bottom side, center rear	Charger proximity temperature	Excessive temperature on the logic board near the battery connector.
TH0a	Logic board top side, left, near large flash storage ICs	Flash Storage NAND proximity temperature	Excessive flash storage temperature.
TM0P	Logic board bottom side, right front	Memory proximity temperature	Excessive memory temperature.
TSMP	Logic board top side, center	T2 proximity temperature	Excessive temperature on the logic board.
TS0P	IPD board (trackpad)	Trackpad temperature	Excessive temperature on the IPD board or the trackpad is damaged/disconnected from the logic board.
TS1P	Actuator (trackpad)	Trackpad actuator temperature	Excessive temperature at the trackpad actuator or the trackpad is damaged/disconnected from the logic board.
TUDD	Logic board bottom side, left rear	Thunderbolt proximity temperature	Excessive I/O temperature or logic board sensor is damaged or disconnected from SMC. Check USB-C I/O connections and fan operation.
TW0P	Logic board top side, right rear	Wireless proximity temperature	Excessive temperature on the logic board near the wireless IC.

Electrical Sensor Table for MacBook Air (Retina, 13-inch, 2018)

SMC Name	Location	General Description	Units	Diagnosis
IAPC	Logic board	WLAN (Airport) & Bluetooth current	Amperes	Out-of-range wireless current was found or open signal to SMC. Possible issue with the logic board.
IBLR	Logic board	LCD backlight current	Amperes	Out-of-range LCD backlight current was found or open signal to SMC. Possible issue with the display or logic board.
ICAC	Logic board	VDD main current	Amperes	Out of range CPU current was found or open signal to SMC.
IC0R	Logic board	CPU computing high side current	Amperes	Out-of-range CPU current was found or open signal to SMC. Possible issue with the logic board.
IHCC	Logic board	Flash storage current	Amperes	Out-of-range flash storage current was found or open signal to SMC. Possible issue with the logic board.
ID0R	Logic board	DC in rail current	Amperes	Out-of-range DC-IN power current. Possible defective I/O board or flex cable, or open signal to SMC. Verify the correct power adapter, charge cable, and flex cable connections.
IO3R	Logic board	Other 3.3V high side current	Amperes	Out of range current from the CPU's integrated voltage regulators.
IO5R	Logic board	Other 5V high side current	Amperes	Out of range current from the CPU's integrated voltage regulators.
IPBR	Logic board	PBus on battery current	Amperes	Out-of-range current from battery or charge circuitry found on the logic board, or open signal to SMC. Use the correct power adapter and verify that the USB-C charging cable connector pins are clean and make a good electrical connection. Disconnect and reconnect the battery to reseal the logic board connection. Recharge the battery.
IT3C	Logic board	Trackpad & Keyboard 3.3V current	Amperes	Out of range keyboard or trackpad current found or open signal to SMC.
VCAC	Logic board	CPU IA Core voltage	Volts	Out of range voltage from the CPU's integrated voltage regulators.
VD0R	Logic board	DC-in voltage	Volts	Out-of-range DC-IN voltage. Possible defective power adapter. Verify the correct power adapter, charge cable, and I/O flex cable connections.
VP0R	Logic board	PBus rail voltage	Volts	Out-of-range voltage from battery or charge circuitry found on the logic board, or open signal to SMC. Use the correct power adapter and verify that the USB-C charging cable connector pins are clean and make a good electrical connection. Disconnect and reconnect the battery to reseal the logic board connection. Recharge the battery.
VHNC	Logic board	Flash Storage NAND 2.7V voltage	Volts	Out-of-range SSD NAND voltage was found or open signal to SMC. Possible issue with the logic board.
VCIC	Logic board	CPU Vcc I/O voltage	Volts	Out-of-range I/O voltage was found or open signal to SMC. Verify the correct power adapter, charge cable, and I/O flex cable connections.

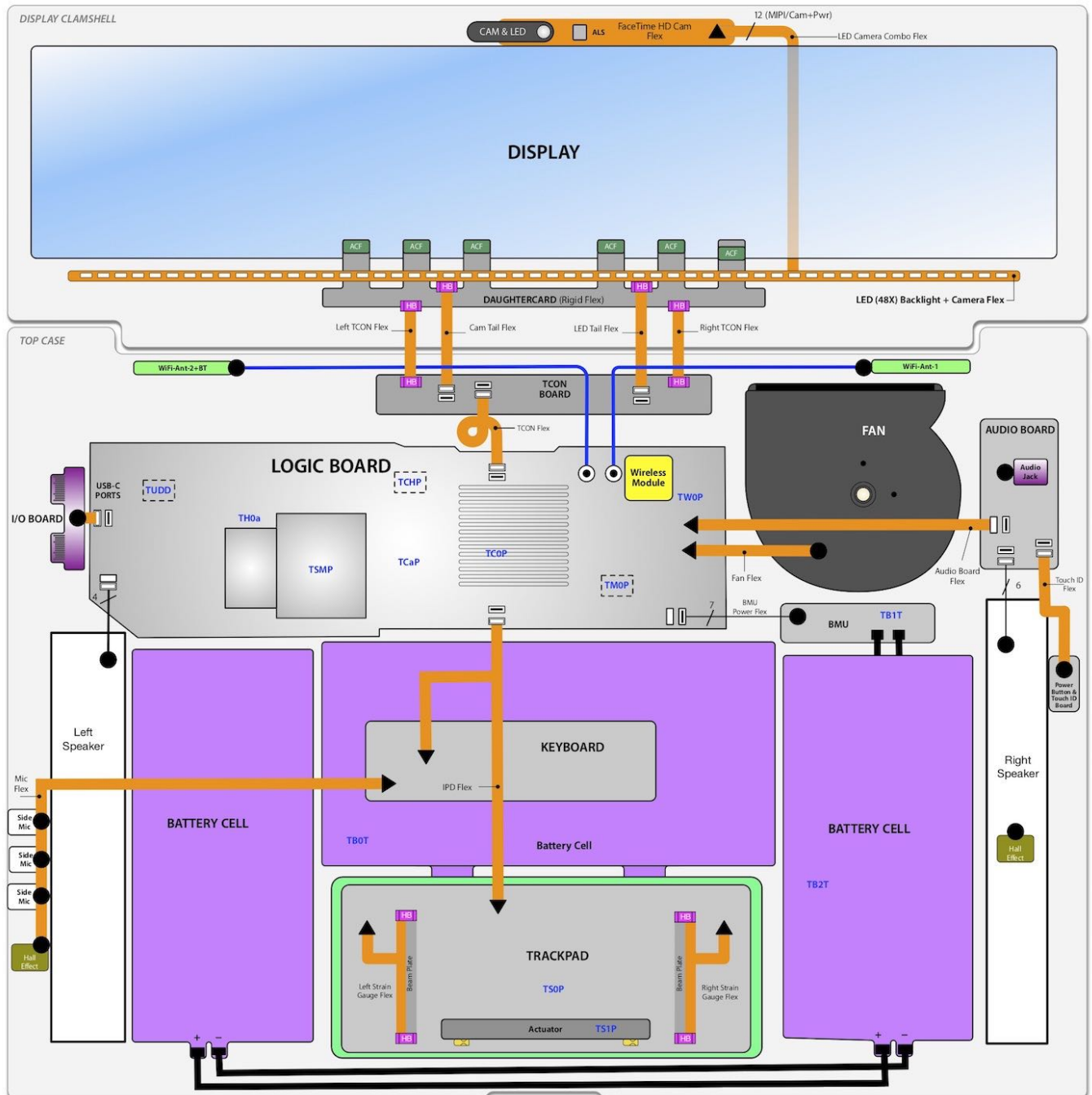
Temperature Concerns

The normal operating temperature of Mac notebook computers is well within national and international safety standards. Nevertheless, a user may be concerned that their computer is warm. To prevent an unnecessary repair, compare the user's computer to a similar running model with a similar load if available.

For more information, refer to the following articles:

- [HT201640: Keep your Mac notebook within acceptable operating temperatures](#)
- [HT203184: See how apps affect Mac performance, battery runtime, temperature, and fan activity](#)
- [HT202179: About fans and fan noise in your Apple product](#)

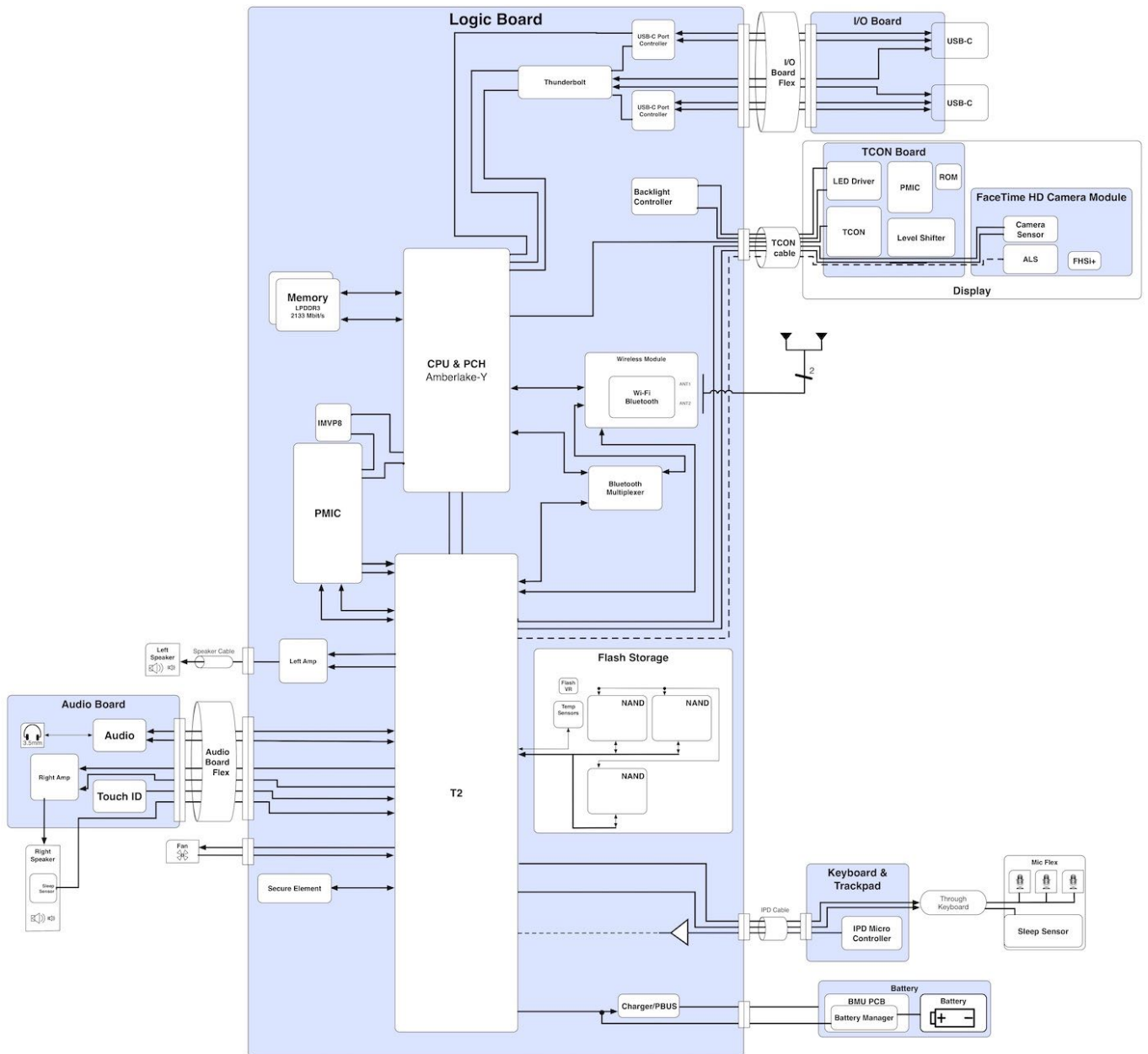
Refer to this diagram to see how modules are interconnected.



Block Diagram

Block Diagram for MacBook Air (Retina, 13-inch, 2018)

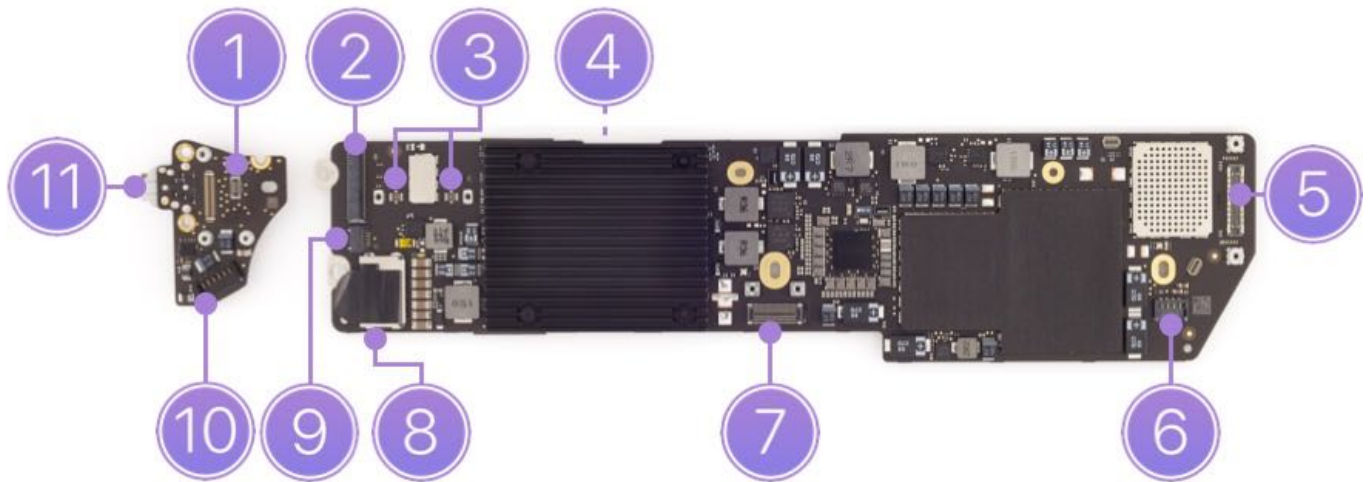
Refer to this diagram to see how modules are interrelated.



Functional Overview

Functional Overview for MacBook Air (13-inch, 2018)

Refer to this diagram for symptoms related to logic board connectors.



1 = Touch ID / Power Button flex

- Will not turn on from power button
- Will not authenticate using Touch ID

2 = Audio Board flex cable connector (connects between logic board and audio board, carries signals for audio port, Touch ID, and right sleep sensor)

- No external audio input
- No headphone audio output
- No headset controls or mic input
- No audio from right speaker
- Will not turn on from power button
- Will not authenticate using Touch ID
- No sleep when display closed
- No wake when display opened
- No video to internal display, but video to external display if one is connected (sensor stuck)

3 = Wi-Fi + Bluetooth antenna connectors

- No/poor Wi-Fi reception
- Drops Wi-Fi connection
- Does not pair with Bluetooth devices
- Drops Bluetooth connection

4 = Timing Controller (TCON) flex cable (also carries FaceTime HD camera and ambient light sensor signals)

- No video, blurred, distorted, or monochrome video on display
- No display backlight
- Display does not dim in low light conditions
- Keyboard backlight cannot be enabled
- Camera does not function

5 = I/O Board (two USB-C ports)

- No power
- No battery charge
- Power adapter issues
- USB connectivity issues
- USB power issues
- No video to external display
- No audio to external display speakers
- Thunderbolt device not found
- Thunderbolt controller not recognized
- Thunderbolt driver issue

- Thunderbolt power issues

6 = Left Speaker

- No audio from left speaker
- Distorted audio from left speaker

7 = IPD flex cable (carries signals for keyboard, trackpad, tri-mic, and left sleep sensor)

- No Multi-Touch or cursor movement from built-in trackpad
- No click action from built-in trackpad
- No keyboard backlight
- Non-responsive keys
- No microphone audio input (with Internal Microphone selected in Sound Input Preferences)
- Distorted microphone audio input
- No sleep when display closed
- No wake when display opened
- No video to internal display, but video to external display if one is connected (sensor stuck)

8 = Battery

- No power
- Not charging (verify with correct model of power adapter)
- X symbol for battery in menu bar

9 = Fan flex cable

- Fan not running
- Intermittent shutdown

10 = Right Speaker (also carries right sleep sensor signals)

- No audio from right speaker
- Distorted audio from right speaker
- No sleep when display closed
- No wake when display opened
- No video to internal display, but video to external display if one is connected (sensor stuck)

11 = Audio port

- No external audio input
- No headphone audio output
- No headset controls or mic input

Bluetooth Issues

Unlikely causes:

AC wall adapter (duckhead), audio board, audio board flex cable, battery, bottom case, display assembly, fan, I/O board, IPD flex cable, power adapter, speakers, TCON flex cable, top case assembly, Touch ID board, trackpad, USB-C charging cable.

Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none">• Bluetooth service not available• Cannot turn Bluetooth on• Bluetooth can be turned on, but the computer is unable to pair with a known-good Bluetooth device• Intermittent loss of communication with paired Bluetooth device• Data transfer over Bluetooth times out or is too slow <p>Note: Inform the user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options. Refer to OP14: Determining and quoting accidental damage for Mac portables.</p>	<p>Important: Disable Auto Boot before performing any troubleshooting steps that require disassembly of the computer, and reenable Auto Boot after the computer has been reassembled and service is completed. Follow steps in TP1484: Auto Boot to enable or disable this function.</p> <ol style="list-style-type: none">1. In System Preferences > Bluetooth, check that Bluetooth is on.2. Attempt to pair the computer with a known-good Bluetooth keyboard, mouse, or trackpad.3. Reset the Bluetooth device or delete the pairing (if applicable).4. Refer to HT201260: How to find the macOS version number on your Mac to check that the system build is correct for this computer model.5. Check for and apply the latest software and firmware updates.6. If the customer is using a USB 3 device, review HT201163: Using USB devices with your Mac to identify possible interference with Wi-Fi and Bluetooth communications if the device is positioned near their antennas.7. If the user's computer pairs Bluetooth normally at your service location, research potential sources of interference in the user's environment, such as microwave ovens or cordless phones in the 2.4/5GHz range. Refer to HT201542: Potential sources of Wi-Fi and Bluetooth interference.8. Reset the NVRAM using the procedure for this computer in HT204063: Reset NVRAM or PRAM on your Mac.9. Reset the SMC using the procedure for this computer in HT201295: How to reset the System Management Controller (SMC) on your Mac.

Deep Dive

	Check	Result	Action	Code	Commodity
1.	<p>Check Mac Resource Inspector diagnostic suite (MRI) test results or System Information > Hardware > USB device tree to verify that the Bluetooth controller is listed.</p> <p>Is Bluetooth hardware detected?</p>	Yes	Go to step 2.	\$(nodeText.yesSymptomCode)	MLB
		No	<p>Replace the logic board and Touch ID board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M36	
2.	<p>Open System Preferences > Bluetooth. Remove all paired devices. Pair the computer with a known-good Bluetooth device.</p> <p>Does the computer pair with a known-good Bluetooth device?</p>	Yes	Go to the “External Apple Bluetooth Peripherals” troubleshooting flow.	\$(nodeText.yesSymptomCode)	
		No	Go to step 3.	\$(nodeText.noSymptomCode)	
3.	<p>Follow steps in HT208198: About Startup Security Utility to enable starting up from an external storage device on the user’s computer.</p> <p>Start up the computer to a known-good external macOS startup volume.</p> <p>Try to connect to the known-good Bluetooth device. Compare Bluetooth performance and reliability to a known-good computer of similar type and Bluetooth specification.</p> <p>Does the issue persist with known-good macOS?</p>	Yes	Go to step 4.	\$(nodeText.yesSymptomCode)	
		No	<p>Reinstall macOS on the user’s computer.</p> <p>Check for and apply the latest software and firmware updates.</p> <p>Verify that the issue is resolved.</p>	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
4.	<p>Locate the wireless antenna connectors on the logic board. Unplug them and inspect the antenna cables and their connectors for any signs of pinched wires or connector damage.</p> <p>Do the antenna cables or connectors show signs of damage?</p>	Yes	<p>Replace the vent/antenna module.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	X03	OTHER ELECTRIC
		No	Go to step 5.	\${nodeText.noSymptomCode}	
5.	<p>With the antenna cables unplugged, inspect the wireless antenna cable connectors on the logic board for housing or pin damage.</p> <p>Do the antenna connectors on the logic board show signs of damage?</p>	Yes	<p>Replace the logic board and Touch ID board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M24	MLB
		No	Go to step 6.	\${nodeText.noSymptomCode}	
6.	<p>Reseat the antenna cable connectors to the logic board, then retry pairing with a known-good Bluetooth device.</p> <p>Is the computer able to pair with a known-good Bluetooth device?</p>	Yes	The issue was resolved by reseating the wireless antenna connectors to the logic board. Verify that the issue is resolved.	\${nodeText.yesSymptomCode}	
		No	Go to step 7.	\${nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
7.	<p>Troubleshooting this issue completely requires the following known-good parts:</p> <ul style="list-style-type: none"> Logic board Vent/antenna module <p>Do you have immediate access to each of these known-good parts?</p>	Yes	Go to step 8.	\${nodeText.yesSymptomCode}	
		No	<p>Replace the logic board and Touch ID board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M36	MLB
8.	<p>Substitute known-good vent/antenna module, then retry pairing with a known-good Bluetooth device.</p> <p>Is the computer able to pair with a known-good Bluetooth device?</p>	Yes	<p>Replace the vent/antenna module.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	X03	OTHER ELECTRIC
		No	Go to step 9.	\${nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
9.	Substitute a known-good logic board. Retry pairing with a known-good Bluetooth device. Is the computer able to pair with a known-good Bluetooth device?	Yes	Replace the logic board and Touch ID board. Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair. Verify that the issue is resolved.	M36	MLB
		No	ESCALATION REQUIRED. Contact ACS for additional support or a multipart repair.	X99	
10.	Pair with a known-good Bluetooth device and verify that the connection is sustained for several minutes. Run AST 2 Full System diagnostic suites (EFI & OS), if available, to ensure no other issues remain. Is the issue resolved?	Yes	The issue is resolved.	`\${nodeText.yesSymptomCode}`	
		No	ESCALATION REQUIRED. Contact ACS for additional support or a multipart repair.	X99	

Wi-Fi Issues

Unlikely causes:

AC wall adapter (duckhead), audio board, audio board flex cable, battery, bottom case, display assembly, fan, I/O board, IPD flex cable, power adapter, speakers, TCON flex cable, top case assembly, Touch ID board, trackpad, USB-C charging cable.

Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none">• Wi-Fi service not available• Cannot turn Wi-Fi on• Wi-Fi can be turned on, but cannot connect to known-good Wi-Fi network• Intermittent loss of Wi-Fi communication• Poor Wi-Fi signal <p>Note: Inform the user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options. Refer to OP14: Determining and quoting accidental damage for Mac portables.</p>	<p>Important: Disable Auto Boot before performing any troubleshooting steps that require disassembly of the computer, and reenable Auto Boot after the computer has been reassembled and service is completed. Follow steps in TP1484: Auto Boot to enable or disable this function.</p> <ol style="list-style-type: none">1. In System Preferences > Network, check that Wi-Fi is on.2. Attempt to connect the computer to a known-good Wi-Fi network.3. Create a new network location in System Preferences.4. Refer to HT201260: How to find the macOS version number on your Mac to check that the system build is correct for this computer model. Using Ethernet network interface, connect to the Internet, then check for and apply latest software and firmware updates.5. If the customer is using a USB 3 device, review HT201163: Using USB devices with your Mac to identify possible interference with Wi-Fi and Bluetooth communications if the device is positioned near their antennas.6. If the user's computer connects normally to Wi-Fi at your service location, research potential sources of interference in the user's environment, such as microwave ovens or cordless phones in the 2.4/5GHz range. Refer to HT201542: Potential sources of Wi-Fi and Bluetooth interference.7. Refer to HT202663: Check for Wi-Fi issues using your Mac to familiarize yourself with the macOS Wireless Diagnostic utility.8. Reset the NVRAM using the procedure for this computer in HT204063: Reset NVRAM or PRAM on your Mac.9. Reset the SMC using the procedure for this computer in HT201295: How to reset the System Management Controller (SMC) on your Mac.

Deep Dive

	Check	Result	Action	Code	Commodity
1.	<p>Check Mac Resource Inspector (MRI) test results or System Information > Network > Wi-Fi to verify that the wireless module is listed.</p> <p>Is Wi-Fi hardware detected?</p>	Yes	Go to step 2.	`\${nodeText.yesSymptomCode}`	
		No	<p>Replace the logic board and Touch ID board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M35	MLB
2.	<p>Run Wireless Diagnostics by holding down the Option key, clicking the wireless icon in the menu bar, and then choosing Open Wireless Diagnostics.</p> <p>Wireless Diagnostics can also be found at: /System/Library/CoreServices/Applications/WirelessDiagnostics.app</p> <p>Does the computer complete Wireless Diagnostics with no issues?</p>	Yes	Go to step 3.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 4.	`\${nodeText.noSymptomCode}`	
3.	<p>Connect to a known-good wireless network and open Wireless Diagnostics > Window > Performance. Review the quality graph to evaluate the signal quality of the wireless connection. Verify that the signal is good or excellent, and that the transmission rate (Tx Rate) is comparable to another known-good computer of similar type and Wi-Fi specification. Where available, switch between 2.4GHz and 5GHz networks to verify that the signal quality is comparable to a known-good computer.</p> <p>Using a network with a high transmission rate, download a large file from a known-good website or file server. Compare network performance to another known-good computer of similar type and Wi-Fi specification. Verify throughput using Activity Monitor > Network.</p> <p>Are the performance and throughput comparable between the user's computer and a known-good computer?</p>	Yes	Wi-Fi performance is within specification. Verify that the issue is resolved.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 4.	`\${nodeText.noSymptomCode}`	

	Check	Result	Action	Code	Commodity
4.	Use one of the following two methods to start up the computer to a known-good macOS.	Yes	Go to step 5.	`\${nodeText.yesSymptomCode}`	
	<p>Start up the computer to macOS Recovery. See HT201314: About macOS Recovery.</p> <p>Follow steps in HT208198: About Startup Security Utility to enable starting up from an external storage device on the user's computer. Then start up the computer to a known-good external macOS startup volume.</p> <p>Attempt to reproduce the Wi-Fi performance or connection issue.</p> <p>Does the issue persist with known-good macOS?</p>	No	<p>Reinstall macOS on the user's computer.</p> <p>Check for and apply the latest software and firmware updates.</p> <p>Verify that the issue is resolved.</p>	`\${nodeText.noSymptomCode}`	
5.	<p>Locate the wireless antenna connectors on the logic board. Unplug them and inspect the antenna cables and their connectors for any signs of pinched wires or connector damage.</p> <p>Do the antenna cables or connectors show signs of damage?</p>	Yes	<p>Replace the vent/antenna module.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	X03	OTHER ELECTRIC
		No	Go to step 6.	`\${nodeText.noSymptomCode}`	

	Check	Result	Action	Code	Commodity
6.	<p>With the antenna cables unplugged, inspect the wireless antenna cable connectors on the logic board for housing or pin damage.</p> <p>Do the antenna connectors on the logic board show signs of damage?</p>	Yes	<p>Replace the logic board and Touch ID board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M24	MLB
		No	Go to step 7.	`\${nodeText.noSymptomCode}`	
7.	<p>Reseat the antenna cable connectors to the logic board, then connect to a known-good Wi-Fi network.</p> <p>Is the computer able to connect to a known-good Wi-Fi network?</p>	Yes	The issue was resolved by reseating the wireless antenna connectors to the logic board. Verify that the issue is resolved.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 8.	`\${nodeText.noSymptomCode}`	
8.	<p>Troubleshooting this issue completely requires a known-good vent/antenna module.</p> <p>Do you have immediate access to a known-good vent/antenna module?</p>	Yes	Go to step 9.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 10.	`\${nodeText.noSymptomCode}`	

	Check	Result	Action	Code	Commodity
9.	<p>Substitute known-good vent/antenna module, then connect to a known-good Wi-Fi network.</p> <p>Is the computer able to connect to a known-good Wi-Fi network?</p>	Yes	<p>Replace the vent/antenna module.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	X03	OTHER ELECTRIC
		No	Go to step 10.	`\${nodeText.noSymptomCode}`	
10.	<p>Determine if the following symptom was observed on the user's computer:</p> <p>No Wi-Fi signal.</p> <p>Does this symptom accurately describe the user's issue?</p>	Yes	<p>Replace the logic board and Touch ID board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M40	MLB
		No	Go to step 11.	`\${nodeText.noSymptomCode}`	

	Check	Result	Action	Code	Commodity
11.	<p>Determine if the following symptom was observed on the user's computer:</p> <p>Cannot connect to a known-good Wi-Fi network.</p> <p>Does this symptom accurately describe the user's issue?</p>	Yes	<p>Replace the logic board and Touch ID board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M41	MLB
		No	Go to step 12.	\${nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
12.	<p>Determine if the following symptom was observed on the user's computer:</p> <p>Onboard Wi-Fi Performance issue.</p> <p>Does this symptom accurately describe the user's issue?</p>	Yes	<p>Replace the logic board and Touch ID board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M42	MLB
		No	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	X99	
13.	<p>Connect to a known-good wireless network and retest data throughput, checking for adequate transfer speeds.</p> <p>Verify that wireless connection is sustained for several minutes.</p> <p>Run AST 2 Full System diagnostic suites (EFI & OS), if available, to ensure no other issues remain.</p> <p>Verify that the issue is resolved.</p> <p>Is issue resolved?</p>	Yes	The issue is resolved.	\${nodeText.yesSymptomCode}	
		No	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	X99	

Backlight Issues or No Backlight

Unlikely causes:

AC wall adapter (duckhead), audio board, audio board flex cable, battery, bottom case, fan, I/O board, IPD flex cable, power adapter, speakers, top case assembly, Touch ID board, trackpad, USB-C charging cable, vent / antenna module.

Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none">Display not illuminatedDisplay backlight fails after warm-upDisplay backlight fails at certain brightness settingsComputer appears to turn on and operate, but no image is seen on the display <p>Note: Inform the user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options. Refer to OP14: Determining and quoting accidental damage for Mac portables.</p>	<p>Important: Disable Auto Boot before performing any troubleshooting steps that require disassembly of the computer, and reenable Auto Boot after the computer has been reassembled and service is completed. Follow steps in TP1484: Auto Boot to enable or disable this function.</p> <ol style="list-style-type: none">Check for and apply the latest software and firmware updates.Refer to HT201260: How to find the macOS version number on your Mac to check that the system build is correct for this computer model.Reset the NVRAM using the procedure for this computer in HT204063: Reset NVRAM or PRAM on your Mac.Reset the SMC using the procedure for this computer in HT201295: How to reset the System Management Controller (SMC) on your Mac.Adjust the brightness to the maximum setting.Put the display to sleep by pressing Shift-Control-Power. Wait five seconds, then wake the display by pressing any key.

Deep Dive

	Check	Result	Action	Code	Commodity
1.	Connect an external display with USB-C Digital AV Multiport Adapter or USB-C VGA Multiport Adapter. Check to see if the external monitor displays video at startup. Does the external display show a video signal?	Yes	Go to step 2.	\$(nodeText.yesSymptomCode)	
		No	Go to the “Power But No Video” troubleshooting flow.	\$(nodeText.noSymptomCode)	
2.	Check Mac Resource Inspector (MRI) results to verify that the LCD is detected. If Apple Service Toolkit (AST) 2 is not available, go to System Information > Graphics/Displays to verify that the color LCD is recognized. Does MRI or System Information detect the internal LCD panel?	Yes	Go to step 3.	\$(nodeText.yesSymptomCode)	
		No	Go to the “Power But No Video” troubleshooting flow.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
3.	<p>Start up the computer normally. Clean the display glass of all fingerprints and dirt, then shine a bright light on the display to illuminate it.</p> <p>The Apple menu icon in the menu bar should always be visible and provide a reliable, high-contrast, and identifiable icon.</p> <p>Does the display show a legible image despite not being backlit?</p>	Yes	Go to step 4.	\$(nodeText.yesSymptomCode)	
		No	Go to the “Power But No Video” troubleshooting flow.	\$(nodeText.noSymptomCode)	
4.	<p>Follow Service Guide procedures to remove the bottom case and disconnect the battery from the logic board.</p> <p>Disconnect and inspect the TCON flex cable for damage. Look for pinching or crimping, and damaged or bent pins.</p> <p>Does the TCON flex cable show signs of damage?</p>	Yes	Go to step 5.	\$(nodeText.yesSymptomCode)	
		No	Go to step 6.	\$(nodeText.noSymptomCode)	
5.	<p>Inspect the logic board and display TCON flex connectors for damage.</p> <p>Is the connector on the logic board or display also damaged?</p>	Yes	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	X99	
		No	<p>Replace the TCON flex cable.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>	X03	INTERNAL CABLE

	Check	Result	Action	Code	Commodity
6.	<p>Inspect the logic board TCON connector for damage.</p> <p>Does the connector on the logic board show signs of damage?</p>	Yes	<p>Replace the logic board and Touch ID board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M24	MLB
		No	Go to step 7.	\$(nodeText.noSymptomCode)	
7.	<p>Inspect the display TCON connector for damage.</p> <p>Does the connector on the display show signs of damage?</p>	Yes	<p>Replace the display assembly.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	L14	LCD
		No	Go to step 8.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
8.	<p>Reseat the TCON flex cable connectors on the logic board and display. Reseating the cable can restore normal video.</p> <p>Reassemble the computer and retest for display backlight functionality.</p> <p>An NVRAM reset may be required if the brightness was lowered during troubleshooting.</p> <p>Is backlight functionality restored?</p>	Yes	<p>The issue was resolved by reseating the TCON flex cable.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>	\${nodeText.yesSymptomCode}	
		No	Go to step 9.	\${nodeText.noSymptomCode}	
9.	<p>Troubleshooting this issue completely requires a known-good TCON flex cable.</p> <p>Do you have immediate access to a known-good TCON flex cable?</p>	Yes	Go to step 10.	X03	INTERNAL CABLE
		No	<p>Replace the TCON flex cable.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>		
10.	<p>Substitute a known-good TCON flex cable and retest backlight function.</p> <p>Is backlight functionality restored?</p>	Yes	<p>Replace the TCON flex cable.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>	X03	INTERNAL CABLE
		No	Go to step 11.	\${nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
11.	<p>Locate display backlight fuse on logic board. Refer to OP478: Backlight fuse location images. Test fuse continuity using a digital multimeter. For instruction on using a multimeter, see HT3250: Using a digital multimeter.</p> <p>Note: A good fuse will have a measurement of zero to one ohm. If the fuse measures higher than one (>1) ohm, it is burned out. This may indicate a display backlight short. If so, this short could burn out a second logic board. Both the display and logic board should be replaced simultaneously to prevent further part damage.</p> <p>Is display backlight fuse burned out?</p>	Yes	Go to step 12.	\$(nodeText.yesSymptomCode)	
		No	Go to step 15.	\$(nodeText.noSymptomCode)	
12.	<p>Troubleshooting this issue completely requires the following known-good parts:</p> <ul style="list-style-type: none"> display assembly logic board <p>Do you have immediate access to both known-good parts?</p>	Yes	Go to step 13.	\$(nodeText.yesSymptomCode)	
		No	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	M25	
13.	<p>Substitute a known-good display assembly and known-good logic board, and retest backlight function.</p> <p>Is backlight functionality restored?</p>	Yes	Go to step 14.	\$(nodeText.yesSymptomCode)	
		No	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	M25	

	Check	Result	Action	Code	Commodity
14.	<p>Reinstall the user's display assembly.</p> <p>Continue to use a known-good logic board and retest backlight function.</p> <p>Is backlight functionality restored?</p>	Yes	<p>Replace the logic board and Touch ID board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M25	MLB
		No	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	M25	
15.	<p>Troubleshooting this issue completely requires a known-good display assembly.</p> <p>Do you have immediate access to a known-good display assembly?</p>	Yes	Go to step 16.	`\${nodeText.yesSymptomCode}`	
		No	<p>Replace the display assembly.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	L09	LCD

	Check	Result	Action	Code	Commodity
16.	Substitute a known-good display assembly and retest backlight function.	Yes	<p>Replace the display assembly.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	L09	LCD
	Is backlight functionality restored?	No	<p>Replace the logic board and Touch ID board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M25	MLB
17.	Restart the computer and verify that the internal display, backlight, camera, and ambient light sensor are functioning normally.	Yes	The issue is resolved.	\$(nodeText.yesSymptomCode)	
	<p>Run AST 2 Full System diagnostic suites (EFI & OS), if available, to ensure no other issues remain.</p> <p>Are all issues resolved?</p>	No	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	X99	

Corrupted or Distorted Video

Unlikely causes:

AC wall adapter (duckhead), audio board, audio board flex cable, battery, bottom case, fan, I/O board, IPD flex cable, power adapter, speakers, top case assembly, Touch ID board, trackpad, USB-C charging cable, vent / antenna module.

Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none">• Distorted or illegible image on the display• Inconsistent clarity of image• Image flicker• Video “noise”• Cannot change resolution on display <p>Note: Inform the user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options. Refer to OP14: Determining and quoting accidental damage for Mac portables.</p>	<p>Important: Disable Auto Boot before performing any troubleshooting steps that require disassembly of the computer, and re-enable Auto Boot after the computer has been reassembled and service is completed. Follow steps in TP1484: Auto Boot to enable or disable this function.</p> <ol style="list-style-type: none">1. Refer to HT201260: How to find the macOS version number on your Mac to check that the system build is correct for this computer model. Incorrect video graphic drivers will not work properly. Check for and apply the latest software and firmware updates.2. Reset the NVRAM using the procedure for this computer in HT204063: Reset NVRAM or PRAM on your Mac.3. Reset the SMC using the procedure for this computer in HT201295: How to reset the System Management Controller (SMC) on your Mac.4. Start up the computer to macOS Recovery. See HT201314: About macOS Recovery.

Deep Dive

	Check	Result	Action	Code	Commodity
1.	Connect a known-good external display, keyboard, and mouse with a known-good USB-C VGA or Digital AV Multiport Adapter. Turn on the computer and close the display assembly. Use an external keyboard or mouse to ensure that the computer stays awake and check to see if the external display correctly displays video. Does the external display also exhibit distorted video?	Yes	Replace the logic board and Touch ID board. Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair. Verify that the issue is resolved.	M31	MLB
		No	Go to step 2.	\$(nodeText.noSymptomCode)	
2.	Check for and apply the latest software and firmware updates. Recheck video on the built-in display. Does the built-in display function normally?	Yes	The issue is resolved. Verify resolution.	\$(nodeText.yesSymptomCode)	
		No	Go to step 3.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
3.	<p>If issue seems to be flickering video, use a bright light to determine if the backlight alone is flickering.</p> <p>Try adjusting the brightness to determine whether the issue is linked solely to the display backlight.</p> <p>Is the symptom visible regardless of the backlight state?</p>	Yes	Go to step 4.	\$(nodeText.yesSymptomCode}	
		No	Go to the “Backlight Issues or No Backlight” troubleshooting flow.	\$(nodeText.noSymptomCode}	
4.	<p>While observing the issue, move the display assembly back and forth.</p> <p>Open and close the display fully several times to make sure the cables are not pinched or shorting.</p> <p>Does the symptom change with display movement?</p>	Yes	Go to step 5.	\$(nodeText.yesSymptomCode}	
		No	Go to step 10.	\$(nodeText.noSymptomCode}	
5.	<p>Follow Service Guide procedures to remove the bottom case and disconnect the battery from the logic board.</p> <p>Disconnect and inspect the TCON flex cable for damage. Look for pinching or crimping, and damaged or bent pins.</p> <p>Does the TCON flex cable show signs of damage?</p>	Yes	Go to step 6.	\$(nodeText.yesSymptomCode}	
		No	Go to step 7.	\$(nodeText.noSymptomCode}	
6.	<p>Inspect the logic board and display TCON flex connectors for damage.</p> <p>Is the connector on the logic board or display also damaged?</p>	Yes	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	X99	
		No	<p>Replace the TCON flex cable.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>	X03	INTERNAL CABLE

	Check	Result	Action	Code	Commodity
7.	<p>Inspect the logic board TCON connector for damage.</p> <p>Does the connector on the logic board show signs of damage?</p>	Yes	<p>Replace the logic board and Touch ID board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M24	MLB
		No	Go to step 8.	\$(nodeText.noSymptomCode)	
8.	<p>Inspect the display TCON connector for damage.</p> <p>Does the connector on the display show signs of damage?</p>	Yes	<p>Replace the display assembly.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	L14	LCD
		No	Go to step 9.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
9.	<p>Reseat the TCON flex cable connectors on the logic board and display. Reseating the cable can restore normal video.</p> <p>Reassemble the computer and retest the internal display with a normal startup.</p> <p>An NVRAM reset may be required if the brightness was lowered during troubleshooting.</p> <p>Is normal video restored?</p>	Yes	<p>The issue was resolved by reseating the TCON flex cable.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>	\${nodeText.yesSymptomCode}	
		No	Go to step 10.	\${nodeText.noSymptomCode}	
10.	<p>Troubleshooting this issue completely requires a known-good TCON flex cable.</p> <p>Do you have immediate access to a known-good TCON flex cable?</p>	Yes	Go to step 11.	X03	INTERNAL CABLE
		No	<p>Replace the TCON flex cable.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>		
11.	<p>Substitute a known-good TCON flex cable and retest the internal display with a normal startup.</p> <p>Is normal video restored?</p>	Yes	<p>Replace the TCON flex cable.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>	X03	INTERNAL CABLE
		No	Go to step 12.	\${nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
12.	Troubleshooting this issue completely requires a known-good display assembly.	Yes	Go to step 13.	\$(nodeText.yesSymptomCode)	
	Do you have immediate access to a known-good display assembly?	No	Go to step 14.	\$(nodeText.noSymptomCode)	
13.	Substitute a known-good display assembly and attempt to reproduce the issue. Was the issue resolved with the known-good display assembly?	Yes	Go to step 14.	\$(nodeText.yesSymptomCode)	
		No	Replace the logic board and Touch ID board.	M04	MLB
			Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair. Verify that the issue is resolved.		
14.	Isolate the original symptom for this issue as: • Full-screen flicker or flash Does this symptom best describe the original issue?	Yes	Replace the display assembly. Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair. Verify that the issue is resolved.	L06	LCD
		No	Go to step 15.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
15.	<p>Isolate the original symptom for this issue as:</p> <ul style="list-style-type: none"> Distorted, blurred, or out-of-focus video <p>Does this symptom best describe the original issue?</p>	Yes	<p>Replace the display assembly.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	L04	LCD
		No	Go to step 16.	\$(nodeText.noSymptomCode)	
16.	<p>Isolate the original symptom for this issue as:</p> <ul style="list-style-type: none"> Cannot change display resolution <p>Does this symptom best describe the original issue?</p>	Yes	<p>Replace the display assembly.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	L10	LCD
		No	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	X99	

	Check	Result	Action	Code	Commodity
17.	Restart the computer and verify the image on the internal display, backlight, camera, and ambient light sensor are functioning normally. Run AST 2 Full System diagnostic suites (EFI & OS), if available, to ensure no other issues remain. Are all issues resolved?	Yes	The issue is resolved.	\${nodeText.yesSymptomCode}	
		No	ESCALATION REQUIRED. Contact ACS for additional support or a multipart repair.	M04	

Cracked Display

Unlikely causes:

There are no unlikely causes for this issue.

Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none">Cracked LCD display	<p>If possible, run the AST or AST 2 MRI diagnostic suite prior to troubleshooting. Check for any service restrictions in the diagnostic results.</p> <ol style="list-style-type: none">Refer to guidelines in TP1138: Visual/Mechanical Inspection (VMI) Guide for Mac Displays. <p>Note: Inform the user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options. Refer to OP14: Determining and quoting accidental damage for Mac portables.</p>

Deep Dive

	Check	Result	Action	Code	Commodity
1.	<p>Determine whether issue involves a safety risk, such as glass fragments.</p> <p>Do not perform procedures that can be a safety risk to you or the user.</p> <p>Can you proceed safely?</p>	Yes	Go to step 2.	`\${nodeText.yesSymptomCode}`	
		No	<p>Replace the display assembly out of warranty.</p> <p>Escalate using safety procedures if user claims injury.</p>	L36	LCD
2.	<p>Refer to TP1138: Visual/Mechanical Inspection (VMI) Guide for Mac Displays.</p> <p>Use the Visual/Mechanical Inspection (VMI) Guide to identify conditions that affect warranty and service eligibility.</p> <p>Is the computer in warranty and eligible for warranty service?</p>	Yes	Go to step 3.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 4.	`\${nodeText.noSymptomCode}`	
3.	<p>Determine whether the display has a single crack or multiple cracks in the LCD.</p> <p>Refer to TP1138: Visual/Mechanical Inspection (VMI) Guide for Mac Displays for specific instructions and criteria.</p> <p>Does the display have a single crack or multiple cracks in the LCD?</p>	Single	Replace the display assembly.	L35	LCD
		Multiple	Replace the display assembly out of warranty.	L36	LCD
4.	<p>Determine whether the computer is eligible for out-of-warranty service or is ineligible for service.</p> <p>Is the computer eligible for out-of-warranty service?</p>	Yes	Go to step 5.	`\${nodeText.yesSymptomCode}`	
		No	Return computer to user. Due to damage, the computer is no longer eligible for support.	`\${nodeText.noSymptomCode}`	
5.	<p>Determine whether the display has a single crack or multiple cracks in the LCD.</p> <p>Refer to TP1138: Visual/Mechanical Inspection (VMI) Guide for Mac Displays for specific instructions and criteria.</p> <p>Does the display have a single crack or multiple cracks in the LCD?</p>	Single	Replace the display assembly.	L35	LCD
		Multiple	Replace the display assembly out of warranty.	L36	LCD

Display Anomalies

Unlikely causes:

AC wall adapter (duckhead), audio board, audio board flex cable, battery, bottom case, fan, I/O board, IPD flex cable, power adapter, speakers, top case assembly, Touch ID board, trackpad, USB-C charging cable, vent / antenna module.

Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none">• Distorted or blurred image• Pixel anomalies• Vertical/horizontal lines• Unstable flickering• Incorrect or missing colors• Nonuniform brightness at specific location• Vertical lines of nonuniform brightness repeating over the display• Image persistence or image sticking on screen• Light leakage around the display <p>Note: Inform the user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options. Refer to article OP14: Determining and quoting accidental damage for Mac portables.</p>	<p>Important: Disable Auto Boot before performing any troubleshooting steps that require disassembly of the computer, and reenable Auto Boot after the computer has been reassembled and service is completed. Follow steps in TP1484: Auto Boot to enable or disable this function.</p> <p>Important: Follow instructions in TP1138: Visual/Mechanical Inspection (VMI) Guide for Mac Displays to identify conditions that affect warranty and service eligibility.</p> <p>Note: Verify the issue after using the computer for a few minutes to warm it, or by following steps in HT207571: Warm a Mac for testing. Doing this may help identify intermittent issues.</p> <ol style="list-style-type: none">1. Compare an image on user's display with the same image on an equivalent, known-good portable computer display. Small variations in display quality are normal and expected and may not indicate a service issue.2. Clean the glass panel and check for dust or debris.3. Check the brightness setting.4. Verify that System Preferences > Universal Access > Seeing > Enhance Contrast is set to Normal.5. Check System Preferences > Displays > Color for possible use of a custom display profile. Set profile to Color LCD.6. Use macOS Recovery to troubleshoot potential software issues. Hold down Command-R during startup to restart from the recovery partition. See HT201314: About macOS Recovery.7. Refer to HT201260: How to find the macOS version number on your Mac to check that the system build is correct for this computer model. Check for and apply the latest software and firmware updates, especially those that deal with display or graphic issues.8. Reset the NVRAM using the procedure for this computer in HT204063: Reset NVRAM or PRAM on your Mac.9. Reset the SMC using the procedure listed for this computer in HT201295: How to reset the System Management Controller (SMC) on your Mac.

Deep Dive

	Check	Result	Action	Code	Commodity
1.	Follow steps in HT201262: Use safe mode to isolate issues with your Mac to isolate issues with your Mac to start up the computer in safe mode.	Yes	Go to step 3.	\$(nodeText.yesSymptomCode)	
		No	Go to step 2.	\$(nodeText.noSymptomCode)	
	Does issue still occur in Safe Mode?				

	Check	Result	Action	Code	Commodity
2.	Start up computer using an up-to-date, bootable macOS volume. See articles HT201314: About macOS Recovery and HT201686: Use the Mac operating system that came with your Mac, or a compatible newer version.	Yes	Reinstall macOS on the user's computer. Refer to HT201260: How to find the macOS version number on your Mac to check that the system build is correct for this computer model. Check for and apply the latest software and firmware updates. Verify that the issue is resolved.	\$(nodeText.yesSymptomCode)	
	Retest for display issue. Is normal video restored?	No	Go to step 3.	\$(nodeText.noSymptomCode)	
3.	Run Mac Resource Inspector (MRI) suite from AST or AST 2 to check if the display is fully recognized by the computer.	Yes	Go to step 11.	\$(nodeText.yesSymptomCode)	
	If MRI is not available, go to System Information > Graphics/Displays to verify that Color LCD is recognized. Is display hardware detected in MRI?	No	Go to step 4.	\$(nodeText.noSymptomCode)	
4.	Follow Service Guide procedures to remove the bottom case and disconnect the battery from the logic board.	Yes	Go to step 5.	\$(nodeText.yesSymptomCode)	
	Disconnect and inspect the TCON flex cable for damage. Look for pinching or crimping, and damaged or bent pins. Does the TCON flex cable show signs of damage?	No	Go to step 6.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
5.	<p>Inspect the logic board and display TCON flex connectors for damage.</p> <p>Is the connector on the logic board or display also damaged?</p>	Yes	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	X99	
		No	<p>Replace the TCON flex cable.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>	X03	INTERNAL CABLE
6.	<p>Inspect the logic board TCON connector for damage.</p> <p>Does the connector on the logic board show signs of damage?</p>	Yes	<p>Replace the logic board and Touch ID board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M24	MLB
		No	Go to step 7.	\$(nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
7.	<p>Inspect the display TCON connector for damage.</p> <p>Does the connector on the display show signs of damage?</p>	Yes	<p>Replace the display assembly.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	L14	LCD
		No	Go to step 8.	\$(nodeText.noSymptomCode)	
8.	<p>Reseat the TCON flex cable connectors on the logic board and display. Reseating the cable can restore normal video.</p> <p>Reassemble the computer and retest the internal display with a normal startup.</p> <p>An NVRAM reset may be required if the brightness was lowered during troubleshooting.</p> <p>Is normal video restored?</p>	Yes	<p>The issue was resolved by reseating the TCON flex cable.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>	\$(nodeText.yesSymptomCode)	
		No	Go to step 9.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
9.	<p>Troubleshooting this issue completely requires a known-good TCON flex cable.</p> <p>Do you have immediate access to a known-good TCON flex cable?</p>	Yes	Go to step 10.	\$(nodeText.yesSymptomCode)	
		No	<p>Replace the TCON flex cable.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>	X03	INTERNAL CABLE
10.	<p>Substitute a known-good TCON flex cable and retest the internal display with a normal startup.</p> <p>Is normal video restored?</p>	Yes	<p>Replace the TCON flex cable.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>	X03	INTERNAL CABLE
		No	Go to step 11.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
11.	Use the Display Anomalies test suite in Apple Service Toolkit (AST) 2 or compare an image on the user's display with the same image on an equivalent, known-good display.	Yes	Go to the "Corrupted or Distorted Video" troubleshooting flow.	\$(nodeText.yesSymptomCode)	
	<p>Of the eight issues below, determine if "distorted/blurred image" or "unstable flickering" best describes the primary symptom:</p> <ul style="list-style-type: none"> • Distorted/blurred image • Unstable flickering • Vertical/horizontal lines • Pixel anomalies • Nonuniform brightness • Incorrect or missing colors • Light leakage around the display • Image persistence or image sticking on screen <p>Is the primary issue either distortion or flickering of the display image?</p>	No	Go to step 12.	\$(nodeText.noSymptomCode)	
12.	Use the Display Anomalies test suite in AST 2 or compare an image on the user's display with the same image on an equivalent, known-good display.	Yes	Go to step 13.	\$(nodeText.yesSymptomCode)	
	<p>Of the six issues below, determine if "vertical/horizontal lines" or "pixel anomalies" best describes the primary symptom:</p> <ul style="list-style-type: none"> • Vertical/horizontal lines • Pixel anomalies • Nonuniform brightness • Incorrect or missing colors • Light leakage around the display • Image persistence or image sticking on screen <p>Does the primary issue involve either lines or pixels?</p>	No	Go to step 21.	\$(nodeText.noSymptomCode)	
13.	Thoroughly clean the display surface to remove any dust or debris.	Yes	The issue was resolved by cleaning the display. Verify resolution.	\$(nodeText.yesSymptomCode)	
	<p>Examine the cleaned display and try to reproduce the issue.</p> <p>Was the issue resolved by cleaning the display?</p>	No	Go to step 14.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
14.	<p>Shut down the computer and examine the area of the display that is affected by the symptom under a bright light source.</p> <p>Check that the area affected is not damaged by scratches, pits, or damage to the coating of the display.</p> <p>Refer to article TP1138: Visual/Mechanical Inspection (VMI) Guide for Mac Displays for more information.</p> <p>Does the display surface appear damaged?</p>	Yes	<p>Replace the display assembly.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	L19	LCD
		No	Go to step 15.	\$(nodeText.noSymptomCode)	
15.	<p>Start an AST 2 session with the computer and run the Display Anomalies test suite.</p> <p>If AST 2 is not available, attempt to view the affected area against a number of solid-color backgrounds. Use System Preferences > Desktop & Screen Saver > Desktop, and select “Solid Colors” under “Apple” in the left-hand column.</p> <p>Is the issue verified?</p>	Yes	Go to step 16.	\$(nodeText.yesSymptomCode)	
		No	<p>Explain to user that the display is within specifications. Do not replace the display assembly. Verify resolution.</p>	\$(nodeText.noSymptomCode)	
16.	<p>Examine the affected area of the screen and determine whether it appears to be affected by a pixel issue (bright, dark, or foreign material) or an anomalous line (horizontal or vertical).</p> <p>Is the issue in question a vertical or horizontal line or band?</p>	Yes	Go to step 18.	\$(nodeText.yesSymptomCode)	
		No	Go to step 17.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
17.	<p>Use the Display Anomalies test suite in AST 2 to find all pixel anomalies present.</p> <p>If AST 2 is not available, use a solid desktop background in System Preferences > Desktop & Screen Saver.</p> <p>Refer to HT202025: About LCD display pixel anomalies for Apple products released in 2010 and later to determine whether the number of defects in display exceeds specification.</p> <p>Does the number of pixel anomalies exceed the specified limit?</p>	Yes	<p>Replace the display assembly.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	L20	LCD
		No	<p>Explain to user that the display is within specifications. Do not replace the display assembly. Verify resolution.</p>	\$(nodeText.noSymptomCode)	
18.	<p>Troubleshooting this issue completely requires a known-good display assembly.</p> <p>Do you have immediate access to a known-good display assembly?</p>	Yes	Go to step 19.	\$(nodeText.yesSymptomCode)	
		No	Go to step 20.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
19.	<p>Substitute a known-good display assembly to test logic board video output.</p> <p>Is a normal image restored on the display?</p>	Yes	Go to step 20.	\${nodeText.yesSymptomCode}	
		No	<p>Reinstall the user's display assembly.</p> <p>Replace the logic board and Touch ID board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M04	MLB

	Check	Result	Action	Code	Commodity
20.	Observe the symptom on the display and determine whether the lines are vertical or horizontal.	Yes	<p>Replace the display assembly.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	L27	LCD
	Are the lines on the display vertical?	No	<p>Replace the display assembly.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	L26	LCD
21.	Use the Display Anomalies test suite in AST 2 or compare an image on the user's display with the same image on an equivalent, known-good display.	Yes	Go to step 22.	\$(nodeText.yesSymptomCode)	
	<p>Of the four issues below, determine if "nonuniform brightness" best describes the primary symptom:</p> <ul style="list-style-type: none"> • Nonuniform brightness • Incorrect or missing colors • Light leakage around the display • Image persistence or image sticking on screen <p>Is the primary issue nonuniform brightness?</p>	No	Go to step 25.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
22.	<p>Examine the image on the display closely and determine whether the uneven brightness is located on a single location or repeats over the display.</p> <p>Is the nonuniform brightness repeating over the entire display?</p>	Yes	Go to step 23.	\$(nodeText.yesSymptomCode)	
		No	<p>Replace the display assembly.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	L21	LCD
23.	<p>Troubleshooting this issue completely requires a known-good display assembly.</p> <p>Do you have immediate access to a known-good display assembly?</p>	Yes	Go to step 24.	\$(nodeText.yesSymptomCode)	
		No	<p>Replace the display assembly.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	L21	LCD

	Check	Result	Action	Code	Commodity
24.	<p>Substitute a known-good display assembly and retest the issue with a normal startup or by using the Display Anomalies test suite in AST 2.</p> <p>Is a normal image restored on the display?</p>	Yes	<p>Replace the display assembly.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	L21	LCD
		No	<p>Reinstall the user's display assembly.</p> <p>Replace the logic board and Touch ID board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M25	MLB

	Check	Result	Action	Code	Commodity
25.	<p>Use the Display Anomalies test suite in AST 2 or compare an image on the user's display with the same image on an equivalent, known-good display.</p> <p>Of the three issues below, determine if "incorrect or missing colors" best describes the primary symptom:</p> <ul style="list-style-type: none"> • Incorrect or missing colors • Light leakage around the display • Image persistence or image sticking on screen <p>Is the primary issue incorrect or missing colors?</p>	Yes	Go to step 26.	\$(nodeText.yesSymptomCode)	
		No	Go to step 29.	\$(nodeText.noSymptomCode)	
26.	<p>Go to System Preferences > Displays > Color to ensure that Color LCD is selected under the display profile. Inspect the display again for incorrect or missing colors.</p> <p>Did changing the display profile correct the issue?</p>	Yes	The issue was resolved by setting a valid display profile. The user may have created an off-color calibration setting. Verify resolution.	\$(nodeText.yesSymptomCode)	
		No	Go to step 27.	\$(nodeText.noSymptomCode)	
27.	<p>Troubleshooting this issue completely requires a known-good display assembly.</p> <p>Do you have immediate access to a known-good display assembly?</p>	Yes	Go to step 28.	\$(nodeText.yesSymptomCode)	
		No	<p>Replace the display assembly.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	L02	LCD

	Check	Result	Action	Code	Commodity
28.	<p>Substitute a known-good display assembly and retest the issue with a normal startup or by using the Display Anomalies test suite in AST 2.</p> <p>Is a normal image restored on the display?</p>	Yes	<p>Replace the display assembly.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	L02	LCD
		No	<p>Reinstall the user's display assembly.</p> <p>Replace the logic board and Touch ID board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M04	MLB

	Check	Result	Action	Code	Commodity
29.	<p>Use the Display Anomalies test suite in AST 2 or compare an image on the user's display with the same image on an equivalent, known-good display.</p> <p>Of the two issues below, determine if "light leakage around the display" best describes the primary symptom:</p> <ul style="list-style-type: none"> • Light leakage around the display • Image persistence or image sticking on screen <p>Is the primary issue light leakage around the display?</p>	Yes	Go to step 30.	\${nodeText.yesSymptomCode}	
		No	Go to step 32.	\${nodeText.noSymptomCode}	
30.	<p>Troubleshooting this issue completely requires a known-good display assembly.</p> <p>Do you have immediate access to a known-good display assembly?</p>	Yes	Go to step 31.	\${nodeText.yesSymptomCode}	
		No	<p>Replace the display assembly.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	L28	LCD

	Check	Result	Action	Code	Commodity
31.	<p>Substitute a known-good display assembly and retest the issue with a normal startup or by using the Display Anomalies test suite in AST 2.</p> <p>Did replacing the display assembly resolve the issue?</p>	Yes	<p>Replace the display assembly.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	L28	LCD
		No	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	L28	
32.	<p>A display might show a temporary faint remnant of a previous image even after a new image replaces it. Follow instructions using procedure listed for this computer in article TP949: Image Persistence Test to determine if display fails or passes the Image Persistence Test.</p> <p>Does the display fail the Image Persistence Test?</p>	Yes	<p>Replace the display assembly.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	L28	LCD
		No	<p>The display is within specification. Do not replace display assembly.</p>	<p>\$(nodeText.noSymptomCode)</p>	

	Check	Result	Action	Code	Commodity
33.	<p>Verify that the display issue or anomaly is no longer present.</p> <p>Run AST 2 Full System diagnostic suites (EFI & OS), if available, to ensure no other issues remain.</p> <p>Is the issue resolved?</p>	Yes	Issue resolved.	\${nodeText.yesSymptomCode}	
		No	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	M99	

No Video to External Display

Unlikely causes:

AC wall adapter (duckhead), audio board, audio board flex cable, battery, bottom case, display assembly, fan, IPD flex cable, power adapter, speakers, TCON flex cable, Touch ID board, trackpad, USB-C charging cable, vent / antenna module.

Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none">External display not detected by computerExternal display does not show any video, but internal display doesOne external display shows video, but a second external display does not <p>Note: Inform the user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options. Refer to OP14: Determining and quoting accidental damage for Mac portables.</p>	<p>Important: Disable Auto Boot before performing any troubleshooting steps that require disassembly of the computer, and reenable Auto Boot after the computer has been reassembled and service is completed. Follow steps in TP1484: Auto Boot to enable or disable this function.</p> <p>Note: If the user's issue is that the first connected external display functions, but a second connected external display does not function, try steps A through C before continuing with further troubleshooting:</p> <ol style="list-style-type: none">Ask the user if the issue only appears when multiple external displays are connected, or if the issue appears as soon a single external display is connected.If the issue occurs only when multiple external displays are connected, then determine which external display should be connected first, to reproduce the issue during troubleshooting. The issue may only appear when multiple external displays are connected in a specific order.Repeat the troubleshooting procedure steps that follow in this flow with a second known-good USB-C Digital AV Multiport Adapter and two known-good external HDMI displays connected to the user's computer, connected in the order that causes the user's issue to appear. <ol style="list-style-type: none">Gather display type and model information from the user.Always use a known-good USB-C Digital AV Multiport Adapter and known-good HDMI display equipped with internal speakers to verify the issue.Refer to HT201177: Get help with video issues on external displays connected to your Mac for common causes of video issues.On the HDMI display, verify that the correct input has been selected.Connect the video adapter to each USB-C connector on the computer and retest each time to isolate a possible faulty USB-C port on the user's computer.Reset the NVRAM using the procedure for this computer in HT204063: Reset NVRAM or PRAM on your Mac.Reset the SMC using the procedure for this computer in HT201295: How to reset the System Management Controller (SMC) on your Mac. Retest for external video issues.Refer to HT201260: How to find the macOS version number on your Mac to check that the system build is correct for this computer model.With the user's USB-C Digital AV Multiport Adapter or USB-C Digital AV VGA Adapter connected to the computer, check for and apply the latest software and firmware updates.Refer to the following articles to learn more about Thunderbolt connectivity in this computer:<ul style="list-style-type: none">HT207443: Adapters for the Thunderbolt 3 (USB-C) or USB-C port on your MacHT202488: Apple Thunderbolt cables and adapters

Deep Dive

	Check	Result	Action	Code	Commodity
1.	Connect the known-good display, HDMI cable, and USB-C Digital AV Multiport Adapter to the user's computer.	Yes	Go to step 2.	\$(nodeText.yesSymptomCode)	
	Verify that a good image appears on the external display. Does a good image appear on the external display?	No	Go to step 3.	\$(nodeText.noSymptomCode)	
2.	Connect the known-good display and HDMI cable to the user's USB-C Digital AV Multiport Adapter, then to the computer.	Yes	The issue is isolated to the user's display or HDMI cable. Inform the user of findings and refer to HT204388: Connect to HDMI from your Mac for more information.	\$(nodeText.yesSymptomCode)	
	Verify that a good image appears on the external display. Does a good image appear on the external display?	No	The issue is isolated to the user's adapter. Replace the user's USB-C Digital AV Multiport Adapter or USB-C Digital AV VGA Adapter. If user has third-party adapter, refer to manufacturer for support.	X03	EXTERNAL CABLE
3.	Follow steps in HT208198: About Startup Security Utility to enable starting up from an external storage device on the user's computer. Start up the computer to a known-good external macOS startup volume.	Yes	Reinstall macOS on the user's computer. Check for and apply the latest software and firmware updates. Verify that the issue is resolved.	\$(nodeText.yesSymptomCode)	
	Connect the known-good display, HDMI cable, and USB-C Digital AV Multiport Adapter to the user's computer. Verify that a good image appears on the external display. Does a good image appear on the external display?	No	Go to step 4.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
4.	<p>Inspect all USB-C ports on the user's computer for any signs of deformation, damage, or debris that may be blocking the connection. Use compressed air to clear any obstructions or debris.</p> <p>Important: Do not use any metal objects to clear debris or obstructions as this can short the connector and cause damage.</p> <p>Is any USB-C port damaged?</p>	Yes	Go to step 5.	#{nodeText.yesSymptomCode}	
		No	Go to step 6.	#{nodeText.noSymptomCode}	
5.	<p>Inspect the opening on the top case for the damaged USB-C port. Determine whether the opening is misshapen or deformed, preventing proper insertion of the USB plug.</p> <p>Is the opening for the USB-C port damaged or deformed?</p>	Yes	<p>Replace the top case assembly.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	K16	KEYBOARD
		No	<p>Replace the I/O board.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>	M24	OTHER BOARD

	Check	Result	Action	Code	Commodity
6.	<p>Troubleshooting this issue completely requires a known-good I/O board.</p> <p>Do you have immediate access to a known-good I/O board?</p>	Yes	Go to step 7.	#{nodeText.yesSymptomCode}	
		No	<p>Replace the I/O board.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>	M26	OTHER BOARD

	Check	Result	Action	Code	Commodity
7.	<p>Substitute a known-good I/O board and reassemble the computer.</p> <p>Connect the known-good display, HDMI cable, and USB-C Digital AV Multiport Adapter to the user's computer.</p> <p>Verify that a good image appears on the external display.</p> <p>Does a good image appear on the external display?</p>	Yes	<p>Replace the I/O board.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>	M26	OTHER BOARD
		No	<p>Reinstall the user's I/O board.</p> <p>Replace the logic board and Touch ID board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M26	MLB
8.	<p>Restart the computer and verify that a known-good external display works using both VGA and digital AV adapters.</p> <p>Run AST 2 Full System diagnostic suites (EFI & OS), if available, to ensure no other issues remain.</p> <p>Is the issue resolved?</p>	Yes	Issue resolved.	`\${nodeText.yesSymptomCode}`	
		No	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	M99	

Power But No Video

Unlikely causes:

AC wall adapter (duckhead), audio board, audio board flex cable, battery, bottom case, fan, I/O board, IPD flex cable, power adapter, speakers, top case assembly, Touch ID board, trackpad, USB-C charging cable, vent / antenna module.

Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none">Computer turns on, but no video is present on built-in displayVideo is present on external display but not on built-in displayNo video is present on built-in display but Caps Lock key illuminates when pressed <p>Note: Inform the user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options. Refer to article OP14: Determining and quoting accidental damage for Mac portables.</p>	<p>Important: Disable Auto Boot before performing any troubleshooting steps that require disassembly of the computer, and reenable Auto Boot after the computer has been reassembled and service is completed. Follow steps in TP1484: Auto Boot to enable or disable this function.</p> <ol style="list-style-type: none">Use controls to increase screen brightness.Reset the NVRAM using the procedure for this computer in HT204063: Reset NVRAM or PRAM on your Mac.Reset the SMC using the procedure listed for this computer in HT201295: How to reset the System Management Controller (SMC) on your Mac.Disconnect all peripherals.Start up the computer to macOS Recovery. See HT201314: About macOS Recovery.

Deep Dive

	Check	Result	Action	Code	Commodity
1.	Connect a known-good external display, keyboard, and mouse with a known-good USB-C VGA or Digital AV Multiport Adapter. Turn on the computer and close the display assembly. Use an external keyboard or mouse to ensure that the computer stays awake and check to see if the external display correctly displays video.	Yes	Go to step 2.	\$(nodeText.yesSymptomCode)	
	Does the external display function normally?	No	Go to the “No Video to External Display” troubleshooting flow.	\$(nodeText.noSymptomCode)	
2.	Check for and apply the latest software and firmware updates. Recheck video on the built-in display.	Yes	The issue is resolved. Verify resolution.	\$(nodeText.yesSymptomCode)	
	Does the built-in display function normally?	No	Go to step 3.	\$(nodeText.noSymptomCode)	
3.	Start up the computer normally. After cleaning the display glass of all fingerprints and dirt, shine a bright light on the display to illuminate it.	Yes	Go to the “Backlight Issues or No Backlight” troubleshooting flow.	\$(nodeText.yesSymptomCode)	
	The Apple menu icon in the menu bar should always be visible and provide a reliable, high-contrast icon to look for.	No	Go to step 4.	\$(nodeText.noSymptomCode)	
	Does the display show a legible image despite not being backlit?				

	Check	Result	Action	Code	Commodity
4.	<p>While observing the issue, move the display assembly back and forth.</p> <p>Open and close the display fully several times to make sure the cables are not pinched or shorting.</p> <p>Does the symptom change with display movement?</p>	Yes	Go to step 5.	\$(nodeText.yesSymptomCode)	
		No	Go to step 10.	\$(nodeText.noSymptomCode)	
5.	<p>Follow Service Guide procedures to remove the bottom case and disconnect the battery from the logic board.</p> <p>Disconnect and inspect the TCON flex cable for damage. Look for pinching or crimping, and damaged or bent pins.</p> <p>Does the TCON flex cable show signs of damage?</p>	Yes	Go to step 6.	\$(nodeText.yesSymptomCode)	
		No	Go to step 7.	\$(nodeText.noSymptomCode)	
6.	<p>Inspect the logic board and display TCON flex connectors for damage.</p> <p>Is the connector on the logic board or display also damaged?</p>	Yes	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	X99	
		No	<p>Replace the TCON flex cable.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>	X03	INTERNAL CABLE

	Check	Result	Action	Code	Commodity
7.	<p>Inspect the logic board TCON connector for damage.</p> <p>Does the connector on the logic board show signs of damage?</p>	Yes	<p>Replace the logic board and Touch ID board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M24	MLB
		No	Go to step 8.	\$(nodeText.noSymptomCode)	
8.	<p>Inspect the display TCON connector for damage.</p> <p>Does the connector on the display show signs of damage?</p>	Yes	<p>Replace the display assembly.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	L14	LCD
		No	Go to step 9.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
9.	<p>Reseat the TCON flex cable connectors on the logic board and display. Reseating the cable can restore normal video.</p> <p>Reassemble the computer and retest the internal display with a normal startup.</p> <p>An NVRAM reset may be required if the brightness was lowered during troubleshooting.</p> <p>Is normal video restored?</p>	Yes	<p>The issue was resolved by reseating the TCON flex cable.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>	\$(nodeText.yesSymptomCode)	
		No	Go to step 10.	\$(nodeText.noSymptomCode)	
10.	<p>Troubleshooting this issue completely requires a known-good TCON flex cable.</p> <p>Do you have immediate access to a known-good TCON flex cable?</p>	Yes	Go to step 11.	\$(nodeText.yesSymptomCode)	
		No	<p>Replace the TCON flex cable.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>	X03	INTERNAL CABLE
11.	<p>Substitute a known-good TCON flex cable and retest the internal display with a normal startup.</p> <p>Is normal video restored?</p>	Yes	<p>Replace the TCON flex cable.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>	X03	INTERNAL CABLE
		No	Go to step 12.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
12.	<p>Troubleshooting this issue completely requires a known-good display assembly.</p> <p>Do you have immediate access to a known-good display assembly?</p>	Yes	Go to step 13.	\${nodeText.yesSymptomCode}	
		No	<p>Replace the display assembly.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	L03	LCD

	Check	Result	Action	Code	Commodity
13.	Substitute a known-good display assembly and attempt to reproduce the issue. Is normal video restored?	Yes	Replace the display assembly. Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair. Verify that the issue is resolved.	L03	LCD
		No	Reinstall the user's display assembly. Replace the logic board and Touch ID board. Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair. Verify that the issue is resolved.	M03	MLB
14.	Restart the computer and verify the image on the internal display, backlight, camera, and ambient light sensor are functioning normally. Run AST 2 Full System diagnostic suites (EFI & OS), if available, to ensure no other issues remain. Are all issues resolved?	Yes	The issue is resolved.	\$(nodeText.yesSymptomCode)	
		No	ESCALATION REQUIRED. Contact ACS for additional support or a multipart repair.	M03	

Built-In Keyboard Does Not Work Properly

Unlikely causes:

AC wall adapter (duckhead), audio board, audio board flex cable, battery, bottom case, display assembly, fan, I/O board, power adapter, speakers, TCON flex cable, Touch ID board, trackpad, USB-C charging cable, vent / antenna module.

Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none">Letters or characters repeat unexpectedlyLetters or characters do not appearOne or more keys feel “sticky” or do not respond in a consistent mannerOne or more keys feel stuck in down or up positionKey press feels uneven or stiffKey not responding / spongy / not going all the way downDelayed key returnKeycaps or key switch mechanisms broken or missingKeyboard locks upDisplayed characters do not match the keys pressed <p>Note: Inform the user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options. Refer to OP14: Determining and quoting accidental damage for Mac portables.</p>	<p>Important: Disable Auto Boot before performing any troubleshooting steps that require disassembly of the computer, and reenable Auto Boot after the computer has been reassembled and service is completed. Follow steps in TP1484: Auto Boot to enable or disable this function.</p> <ol style="list-style-type: none">Press Caps Lock key to see if LED lights up, indicating at least a partial connection to logic board.In System Preferences > Keyboard > Input Sources, enable Show Input menu in menu bar. From Input menu in the menu bar, select Show Keyboard Viewer. Check if keystrokes on keyboard are recognized in Keyboard Viewer. If built-in keyboard is not functioning, use an external USB keyboard to perform this step.Confirm that correct keyboard layout is selected in System Preferences > Keyboard > Input Sources. Ensure that any keyboard accessibility features have been disabled by checking System Preferences > Accessibility > General and System Preferences > Accessibility > Keyboard.If a Bluetooth keyboard is present and paired with the computer, it may be overriding input commands from the built-in keyboard. Turn off Bluetooth temporarily to isolate the issue to the built-in keyboard.Reset the NVRAM using the procedure for this computer in HT204063: Reset NVRAM or PRAM on your Mac.If letters or characters repeat unexpectedly, then skip all remaining Quick Checks by replying “No” to continue troubleshooting with deep dive steps.If any of the following symptoms is observed, then follow keycap cleaning and replacement instructions in TP1659: Butterfly Mechanism Keycap Replacement. Try tapping each affected key before, after, and during the cleaning process. Doing so helps dislodge any debris that may be blocking normal key operation:<ul style="list-style-type: none">letters or characters do not appearkeys feel sticky or do not respond in a consistent mannera keycap is loose

Deep Dive

	Check	Result	Action	Code	Commodity
1.	Check the keyboard and keycaps for damage by referring to TP1151: Visual/Mechanical Inspection (VMI) Guide for Mac Computers .	Yes	Go to step 2.	<code>\$(nodeText.yesSymptomCode)</code>	
		No	Go to step 3.	<code>\$(nodeText.noSymptomCode)</code>	
	Are there any damaged keycaps?				

	Check	Result	Action	Code	Commodity
2.	1. Refer to TP1659: Butterfly Mechanism Keycap Replacement to remove the affected keycaps. While the keycap is removed, perform the following steps: A. Clean the inner aluminum part of the keycap well to remove any liquid residue that may be present. B. Inspect the switch housing for damage. Keycaps can be replaced, but the switch housing cannot. A damaged switch housing requires replacement of the entire top case.	Yes	Issue resolved by replacing keycaps. Verify resolution.	\${nodeText.yesSymptomCode}	KEYBOARD
	2. Refer to TP1659: Butterfly Mechanism Keycap Replacement to replace the keycap. Do not reuse keycaps. 3. Test the keycap butterfly mechanism to verify that it is functional. Retest the keyboard to verify that all keyboard keys function normally, and the affected keycap or keycaps no longer exhibit this specific symptom. Did this resolve the issue?	No	Replace the top case assembly. Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair. Verify that the issue is resolved.	K27	
3.	Verify that the specific symptom with the user's built-in keyboard is best described as:	Yes	Go to step 4.	\${nodeText.yesSymptomCode}	
	<ul style="list-style-type: none"> Letters or characters repeat unexpectedly. Does this specific symptom describe the issue?	No	Go to step 5.	\${nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
4.	<p>1. Clean the keyboard thoroughly. Refer to HT205662: How to clean the keyboard of your MacBook or MacBook Pro.</p> <p>2. If cleaning the keyboard did not resolve the issue, then refer to TP1659: Butterfly Mechanism Keycap Replacement to remove the affected keycaps. While the keycap is removed, perform the following steps:</p> <p>A. Clean the inner aluminum part of the keycap well to remove any liquid residue that may be present.</p> <p>B. Inspect the switch housing for damage. Keycaps can be replaced, but the switch housing cannot. A damaged switch housing requires replacement of the entire top case</p> <p>3. Refer to TP1659: Butterfly Mechanism Keycap Replacement to replace the keycap. Do not reuse keycaps.</p> <p>4. Test the keycap butterfly mechanism to verify that it is functional.</p> <p>Retest the keyboard to verify that all keyboard keys function normally, and the affected keycaps no longer exhibit this specific symptom.</p> <p>Did this resolve the issue?</p>	Yes	Issue resolved by cleaning.	`\${nodeText.yesSymptomCode}`	KEYBOARD
		No	<p>Replace the top case assembly.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	K61	
5.	<p>Verify that the specific symptom with the user's built-in keyboard is best described as:</p> <ul style="list-style-type: none"> One or more keys feel "sticky" or do not respond in a consistent manner <p>Does this specific symptom describe the issue?</p>	Yes	Go to step 6.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 7.	`\${nodeText.noSymptomCode}`	

	Check	Result	Action	Code	Commodity
6.	<p>1. Refer to HT205662: How to clean the keyboard of your MacBook or MacBook Pro to clean the keyboard. Tap each affected key before, after, and during the cleaning process. Doing so helps dislodge any debris that may be blocking normal key operation.</p> <p>2. If cleaning the keyboard did not resolve the issue, then refer to TP1659: Butterfly Mechanism Keycap Replacement to remove the affected keycaps. While the keycap is removed, perform the following steps:</p> <p>A. Clean the inner aluminum part of the keycap well to remove any liquid residue that may be present.</p> <p>B. Inspect the switch housing for damage. Keycaps can be replaced, but the switch housing cannot. A damaged switch housing requires replacement of the entire top case.</p> <p>3. Refer to TP1659: Butterfly Mechanism Keycap Replacement to replace the keycap. Do not reuse keycaps.</p> <p>4. Test the keycap butterfly mechanism to verify that it is functional.</p> <p>Retest the keyboard to verify that all keyboard keys function normally, and the affected keycaps no longer exhibit this specific symptom.</p> <p>Did this resolve the issue?</p>	Yes	Issue resolved by cleaning.	`\${nodeText.yesSymptomCode}`	KEYBOARD
		No	<p>Replace the top case assembly.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	K05	
7.	<p>Verify that the specific symptom with the user's built-in keyboard is best described as:</p> <ul style="list-style-type: none"> • Keys press feels uneven or stiff. • Keycap not responding / spongy / not going all the way down. • Delayed key return. <p>Does this specific symptom describe the issue?</p>	Yes	Go to step 9.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 8.	`\${nodeText.noSymptomCode}`	

	Check	Result	Action	Code	Commodity
8.	<p>Run the AST 2 Keyboard diagnostic suite to verify that all keys are functional, including modifier keys.</p> <p>Note: Diagnostics only verify keyboard electrical operation. Diagnostics do not verify keyboard mechanical feel and response.</p> <p>If you have verified a mechanical issue with the user's keyboard and diagnostic tests pass, reply "Yes." Clean the keyboard around the affected key. Remove and discard any malfunctioning keycaps. Inspect, clean, and replace keycaps as necessary.</p> <p>Does the keyboard pass testing?</p>	Yes	Go to step 9.	#{nodeText.yesSymptomCode}	
		No	Go to step 11.	#{nodeText.noSymptomCode}	
9.	<p>Refer to HT205662: How to clean the keyboard of your MacBook or MacBook Pro to carefully apply compressed air to clean the keyboard.</p> <p>Use compressed air and spray around the affected key, in the space between the top case and the keycap.</p> <p>Retest the keyboard to verify that all keyboard keys function normally, and the affected keycap or keycaps no longer exhibit this specific symptom.</p> <p>Did this resolve the issue?</p>	Yes	Issue resolved by cleaning.	#{nodeText.yesSymptomCode}	
		No	Go to step 10.	#{nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
10.	<p>1. If cleaning the keyboard did not resolve the issue, then refer to TP1659: Butterfly Mechanism Keycap Replacement to remove the affected keycaps. While the keycap is removed, perform the following steps:</p> <ul style="list-style-type: none"> A. Clean the inner aluminum part of the keycap well to remove any liquid residue that may be present. B. Inspect the switch housing for damage. Keycaps can be replaced, but the switch housing cannot. A damaged switch housing requires replacement of the entire top case. <p>2. Refer to TP1659: Butterfly Mechanism Keycap Replacement to replace the keycap. Do not reuse keycaps.</p> <p>3. Test the keycap butterfly mechanism to verify that it is functional.</p> <p>Retest the keyboard to verify that all keyboard keys function normally, and that the affected keycaps no longer exhibit this specific symptom.</p> <p>Did this resolve the issue?</p>	Yes	Issue resolved by cleaning.	<code>\${nodeText.yesSymptomCode}</code>	KEYBOARD
		No	<p>Replace the top case assembly.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	K62	
11.	<p>A liquid spill can short key signals and stop keyboard operations. Visual inspection indicating liquid spills should be very obvious to you and to user.</p> <p>Remove the bottom case and disconnect battery, then check for spills or liquid damage inside the computer. Refer to the Service Guide for more information about the location of Liquid Contact Indicators inside the computer. Refer to TP1150: Visual/Mechanical Inspection (VMI) Guide for Mac Portables Liquid Damage for guidance.</p> <p>Note: Inform user that computer failures due to accidental damage are not covered, and if applicable, discuss out-of-warranty repair options. Refer to OP14: Determining and quoting accidental damage for Mac portables.</p> <p>Is it obvious that keyboard keys were exposed to a liquid spill?</p>	Yes	Go to step 12.	<code>\${nodeText.yesSymptomCode}</code>	
		No	Go to step 13.	<code>\${nodeText.noSymptomCode}</code>	

	Check	Result	Action	Code	Commodity
12.	<p>Determine whether liquid damage is limited to the top case assembly or whether multiple parts are damaged.</p> <p>Is there liquid damage to multiple parts?</p>	Yes	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or for a multipart repair related to liquid spill observation found during repair.</p>	K90	
		No	<p>Replace the top case assembly.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	K90	KEYBOARD
13.	<p>Disconnect the IPD flex cable from the logic board, keyboard, and trackpad.</p> <p>Check for damage on the IPD flex cable, its connectors, and the trackpad, keyboard, and logic board IPD flex connectors.</p> <p>Inspect connector housings. Look for debris or broken/missing pins that might prevent proper seating.</p> <p>Is there damage to any flex cable or connector?</p>	Yes	Go to step 14.	<p> <code> \${nodeText.yesSymptomCode} </code> </p>	
		No	Go to step 19.	<p> <code> \${nodeText.noSymptomCode} </code> </p>	
14.	<p>Determine whether damage is limited to one of the following components, or multiple parts are damaged:</p> <ul style="list-style-type: none"> • IPD flex cable • Trackpad • Keyboard (part of top case) • logic board <p>Is there damage to multiple parts?</p>	Yes	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	X99	
		No	Go to step 15.	<p> <code> \${nodeText.noSymptomCode} </code> </p>	

	Check	Result	Action	Code	Commodity
15.	<p>Inspect the IPD flex cable for damage. Pay attention to the body of the cable, looking for pinching, tearing, or crimping, and to all ends of the cable.</p> <p>Does the IPD flex cable appear damaged?</p>	Yes	<p>Replace the IPD flex cable.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>	X03	INTERNAL CABLE
		No	Go to step 16.		
16.	<p>Inspect the trackpad IPD flex cable connector for damage.</p> <p>Does the trackpad IPD flex cable connector appear damaged?</p>	Yes	<p>Replace the trackpad.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	K16	MOUSE
		No	Go to step 17.		

	Check	Result	Action	Code	Commodity
17.	<p>Inspect the keyboard IPD flex cable connector for damage.</p> <p>Does the keyboard IPD flex cable connector appear damaged?</p>	Yes	<p>Replace the top case assembly.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	K16	KEYBOARD
		No	Go to step 18.	\$_{nodeText.noSymptomCode}	
18.	<p>Inspect the logic board IPD flex cable connector for damage.</p> <p>Does the logic board IPD flex cable connector appear damaged?</p>	Yes	<p>Replace the logic board and Touch ID board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M24	MLB
		No	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	X99	

	Check	Result	Action	Code	Commodity
19.	<p>Reconnect the IPD flex cable to the keyboard, ensuring a good connection to the keyboard.</p> <p>Reconnect the IPD flex cable to the logic board and trackpad, ensuring a good connection to both ends.</p> <p>Retest for keyboard functionality.</p> <p>Is the keyboard functioning properly?</p>	Yes	<p>Issue resolved by reseating IPD flex cable.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>	\$(nodeText.yesSymptomCode)	
		No	Go to step 20.	\$(nodeText.noSymptomCode)	
20.	<p>Troubleshooting this issue completely requires a known-good IPD flex cable.</p> <p>Do you have immediate access to a known-good IPD flex cable?</p>	Yes	Go to step 21.	\$(nodeText.yesSymptomCode)	
		No	<p>Replace the IPD flex cable.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>	X03	INTERNAL CABLE
21.	<p>Substitute a known-good IPD flex cable.</p> <p>Retest for keyboard functionality.</p> <p>Is the keyboard functioning properly?</p>	Yes	<p>Replace the IPD flex cable.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>	X03	INTERNAL CABLE
		No	Go to step 22.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
22.	Troubleshooting this issue completely requires a known-good top case assembly.	Yes	Go to step 23.	\${nodeText.yesSymptomCode}	
	Do you have immediate access to a known-good top case assembly?	No	Go to step 24.	\${nodeText.noSymptomCode}	
23.	Substitute a known-good top case assembly. Retest for keyboard functionality. Is the keyboard functioning properly?	Yes	Go to step 24.	\${nodeText.yesSymptomCode}	
		No	Reinstall the user's top case assembly. Replace the logic board and Touch ID board. Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair. Verify that the issue is resolved.	M16	MLB
24.	Verify that the specific symptom with the user's built-in keyboard is best described as: <ul style="list-style-type: none"> • Specific keys do not function when pressed. Does this specific symptom describe the issue?	Yes	Replace the top case assembly. Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair. Verify that the issue is resolved.	K01	KEYBOARD
		No	Go to step 25.	\${nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
25.	<p>Verify that the specific symptom with the user's built-in keyboard is best described as:</p> <ul style="list-style-type: none"> One or more keys makes abnormal noise when pressed. <p>Does this specific symptom describe the issue?</p>	Yes	<p>Replace the top case assembly.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	K60	KEYBOARD
		No	<p>Replace the top case assembly.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	K11	KEYBOARD
26.	<p>Restart the computer and verify that the keyboard is functioning normally.</p> <p>Run AST 2 Full System diagnostic suites (EFI & OS), if available, to ensure no other issues remain.</p> <p>Verify that the issue is resolved.</p> <p>Is issue resolved?</p>	Yes	The issue is resolved. Verify resolution.	\${nodeText.yesSymptomCode}	
		No	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	X99	

Built-in Keyboard Has Dim or No Keyboard Backlight

Unlikely causes:

AC wall adapter (duckhead), audio board, audio board flex cable, battery, bottom case, fan, I/O board, power adapter, speakers, Touch ID board, trackpad, USB-C charging cable, vent / antenna module.

Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none">• All keyboard operation is normal except for backlight• Keyboard backlight not detected in a darkened room• Keyboard backlight uneven: some keys are dim or one or more keys are brighter than the others <p>Note: Inform the user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options. Refer to OP14: Determining and quoting accidental damage for Mac portables.</p>	<p>Important: Disable Auto Boot before performing any troubleshooting steps that require disassembly of the computer, and reenable Auto Boot after the computer has been reassembled and service is completed. Follow steps in TP1484: Auto Boot to enable or disable this function.</p> <ol style="list-style-type: none">1. Refer to HT201260: How to find the macOS version number on your Mac to check that the system build is correct for this computer model.2. Check System Preferences > Keyboard to see whether the “Adjust keyboard brightness in low light” option is available and checked. Refer to HT202310: Adjust the brightness of your backlit keyboard.3. The keyboard backlight is enabled only when the ambient light sensor (ALS) detects low light conditions. Check System Preferences > Displays to see whether the “Automatically adjust brightness” option is selected.4. Check ALS functionality by covering the sensor (located on the display assembly near the camera) with your hand to simulate a dark room. Check whether the keyboard backlight brightness increases.5. Keep the ALS covered and use controls to increase the keyboard backlight level.6. Reset the SMC using the procedure for this computer in HT201295: How to reset the System Management Controller (SMC) on your Mac.7. Reset the NVRAM using the procedure for this computer in HT204063: Reset NVRAM or PRAM on your Mac.

Deep Dive

	Check	Result	Action	Code	Commodity
1.	In AST 2, run the Keyboard test suite and verify that the keyboard backlight illuminates at the appropriate part of the test.	Yes	Go to step 14.	<code>\$(nodeText.yesSymptomCode)</code>	
		No	Go to step 2.	<code>\$(nodeText.noSymptomCode)</code>	
	Does the keyboard backlight pass testing?				

	Check	Result	Action	Code	Commodity
2.	Use one of the following two methods to start up the computer to a known-good macOS.	Yes	Go to step 3.	\${nodeText.yesSymptomCode}	
	<p>Start up the computer to macOS Recovery. See HT201314: About macOS Recovery.</p> <p>Follow steps in HT208198: About Startup Security Utility to enable starting up from an external storage device on the user's computer. Then start up the computer to a known-good external macOS startup volume.</p> <p>Attempt to reproduce the trackpad issue.</p> <p>Does the issue persist with known-good macOS?</p>	No	<p>Reinstall macOS on the user's computer.</p> <p>Check for and apply the latest software and firmware updates.</p> <p>Verify that the issue is resolved.</p>	\${nodeText.noSymptomCode}	
3.	Disconnect the IPD flex cable from the logic board, keyboard, and trackpad.	Yes	Go to step 4.	\${nodeText.yesSymptomCode}	
	<p>Check for damage on the IPD flex cable, its connectors, and the trackpad, keyboard, and logic board IPD flex connectors.</p> <p>Inspect connector housings. Look for debris or broken/missing pins that might prevent proper seating.</p> <p>Is there damage to any flex cable or connector?</p>	No	Go to step 9.	\${nodeText.noSymptomCode}	
4.	<p>Determine whether damage is limited to one of the following components, or multiple parts are damaged:</p> <ul style="list-style-type: none"> • IPD flex cable • Trackpad • Keyboard (part of top case) • logic board <p>Is there damage to multiple parts?</p>	Yes	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	X99	
		No	Go to step 5.	\${nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
5.	<p>Inspect the IPD flex cable for damage. Pay attention to the body of the cable, looking for pinching, tearing, or crimping, and all ends of the cable.</p> <p>Does the IPD flex cable appear damaged?</p>	Yes	<p>Replace the IPD flex cable.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>	X03	INTERNAL CABLE
		No	Go to step 6.	\${nodeText.noSymptomCode}	
6.	<p>Inspect the trackpad IPD flex cable connector for damage.</p> <p>Does the trackpad IPD flex cable connector appear damaged?</p>	Yes	<p>Replace the trackpad.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>	K16	MOUSE
		No	Go to step 7.	\${nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
7.	<p>Inspect the keyboard IPD flex cable connector for damage.</p> <p>Does the keyboard IPD flex cable connector appear damaged?</p>	Yes	<p>Replace the top case assembly.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	K16	KEYBOARD
		No	Go to step 8.	\${nodeText.noSymptomCode}	
8.	<p>Inspect the logic board IPD flex cable connector for damage.</p> <p>Does the logic board IPD flex cable connector appear damaged?</p>	Yes	<p>Replace the logic board and Touch ID board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M24	MLB
		No	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	X99	

	Check	Result	Action	Code	Commodity
9.	<p>Reconnect the IPD flex cable to the keyboard, ensuring a good connection to the keyboard.</p> <p>Reconnect the IPD flex cable to the logic board and trackpad, ensuring a good connection to both ends.</p> <p>Retest for keyboard backlight functionality.</p> <p>Is keyboard backlight functionality restored?</p>	Yes	<p>Issue resolved by reseating IPD flex cable.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>	\$(nodeText.yesSymptomCode)	
		No	Go to step 10.	\$(nodeText.noSymptomCode)	
10.	<p>Troubleshooting this issue completely requires a known-good IPD flex cable.</p> <p>Do you have immediate access to a known-good IPD flex cable?</p>	Yes	Go to step 11.	\$(nodeText.yesSymptomCode)	
		No	<p>Replace the IPD flex cable.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>	X03	INTERNAL CABLE
11.	<p>Substitute a known-good IPD flex cable.</p> <p>Retest for keyboard backlight functionality.</p> <p>Is keyboard backlight functionality restored?</p>	Yes	<p>Replace the IPD flex cable.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>	X03	INTERNAL CABLE
		No	Go to step 12.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
12.	Troubleshooting this issue completely requires a known-good top case assembly.	Yes	Go to step 13.	\${nodeText.yesSymptomCode}	
	Do you have immediate access to a known-good top case assembly?	No	Go to step 24.	\${nodeText.noSymptomCode}	
13.	Substitute a known-good top case assembly. Retest for keyboard backlight functionality. Is keyboard backlight functionality restored?	Yes	Go to step 24.	\${nodeText.yesSymptomCode}	
		No	Reinstall the user's top case assembly. Replace the logic board and Touch ID board. Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair. Verify that the issue is resolved.	M16	MLB
14.	The ambient light sensor (ALS) is located near the camera on top center of the display assembly. Check ALS functionality by covering the sensor with your hand to simulate a dark room. Check whether the keyboard backlight brightness increases. Keep the ALS covered and use controls to increase the keyboard backlight level.	Yes	ESCALATION REQUIRED. Contact ACS for additional support or a multipart repair.	X99	
	Does the keyboard backlight brightness change?	No	Go to step 15.	\${nodeText.noSymptomCode}	
15.	Follow Service Guide procedures to remove the bottom case and disconnect the battery from the logic board.	Yes	Go to step 16.	\${nodeText.yesSymptomCode}	
	Disconnect and inspect the TCON flex cable for damage. Look for pinching or crimping, and damaged or bent pins. Does the TCON flex cable show signs of damage?	No	Go to step 17.	\${nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
16.	<p>Inspect the logic board and display TCON flex connectors for damage.</p> <p>Is the connector on the logic board or display also damaged?</p>	Yes	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	X99	
		No	<p>Replace the TCON flex cable.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>	X03	INTERNAL CABLE
17.	<p>Inspect the logic board TCON connector for damage.</p> <p>Does the connector on the logic board show signs of damage?</p>	Yes	<p>Replace the logic board and Touch ID board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M24	MLB
		No	Go to step 18.	<p> <code> \${nodeText.noSymptomCode} </code> </p>	

	Check	Result	Action	Code	Commodity
18.	<p>Inspect the display TCON connector for damage.</p> <p>Does the connector on the display show signs of damage?</p>	Yes	<p>Replace the display assembly.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	L14	LCD
		No	Go to step 19.	\$_{nodeText.noSymptomCode}\$	
19.	<p>Reseat the TCON flex cable connectors on the logic board and display. Reseating the cable can restore ALS functionality which can affect the keyboard backlight.</p> <p>Reassemble the computer and retest for keyboard backlight functionality.</p> <p>An NVRAM reset may be required if the brightness was lowered during troubleshooting.</p> <p>Is keyboard backlight functionality restored?</p>	Yes	<p>The issue was resolved by reseating the TCON flex cable.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>	\$_{nodeText.yesSymptomCode}\$	
		No	Go to step 20.	\$_{nodeText.noSymptomCode}\$	

	Check	Result	Action	Code	Commodity
20.	<p>Troubleshooting this issue completely requires a known-good TCON flex cable.</p> <p>Do you have immediate access to a known-good TCON flex cable?</p>	Yes	Go to step 21.	`\${nodeText.yesSymptomCode}`	
		No	<p>Replace the TCON flex cable.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>	X03	INTERNAL CABLE
21.	<p>Substitute a known-good TCON flex cable and retest for keyboard backlight functionality.</p> <p>Is keyboard backlight functionality restored?</p>	Yes	<p>Replace the TCON flex cable.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>	X03	INTERNAL CABLE
		No	Go to step 22.	`\${nodeText.noSymptomCode}`	

	Check	Result	Action	Code	Commodity
22.	<p>Reinstall the user's TCON flex cable.</p> <p>Troubleshooting this issue completely requires a known-good display assembly.</p> <p>Do you have immediate access to a known-good display assembly?</p>	Yes	Go to step 23.	#{nodeText.yesSymptomCode}	
		No	<p>Replace the display assembly.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	L17	LCD
23.	<p>Substitute a known-good display assembly and retest for keyboard backlight functionality.</p> <p>Is keyboard backlight functionality restored?</p>	Yes	Go to step 24.	#{nodeText.yesSymptomCode}	
		No	<p>Reinstall the user's display assembly.</p> <p>Replace the logic board and Touch ID board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M16	MLB

	Check	Result	Action	Code	Commodity
24.	<p>Reinstall the user's display assembly if it was removed in a previous step.</p> <p>Of the two issues below, determine which issue best describes the primary symptom:</p> <p>A. Keyboard backlight is not detected in a darkened room</p> <p>B. Keyboard backlight is uneven: some keys are dim or one or more keys are brighter than the others</p> <p>Which issue describes the primary symptom?</p>	A	<p>Replace the top case assembly.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	K10	KEYBOARD
		B	<p>Replace the top case assembly.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	K28	KEYBOARD
25.	<p>Restart the computer and verify that the keyboard backlight is functioning normally.</p> <p>Run AST 2 Full System diagnostic suites (EFI & OS), if available, to ensure no other issues remain.</p> <p>Verify that the issue is resolved.</p> <p>Is the issue resolved?</p>	Yes	The issue is resolved.	\${nodeText.yesSymptomCode}	
		No	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	X99	

Built-in Trackpad Issues

Unlikely causes:

AC wall adapter (duckhead), audio board, audio board flex cable, battery, bottom case, display assembly, fan, I/O board, power adapter, speakers, TCON flex cable, Touch ID board, USB-C charging cable, vent / antenna module.

Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none">Cursor does not move with trackpad input.Multi-Touch features are inoperable.Trackpad not responding to clicks.Trackpad has Haptic feedback issues. <p>Note: Inform the user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options. Refer to OP14: Determining and quoting accidental damage for Mac portables.</p>	<p>Important: Disable Auto Boot before performing any troubleshooting steps that require disassembly of the computer, and reenable Auto Boot after the computer has been reassembled and service is completed. Follow steps in TP1484: Auto Boot to enable or disable this function.</p> <ol style="list-style-type: none">Check HT201260: How to find the macOS version number on your Mac to make sure system build is correct for this computer model. The trackpad will not function properly with an older build of macOS. Check for and apply the latest software and firmware updates. Note: You may have to connect a mouse and an external USB keyboard.Check for environmental factors such as humidity, hand lotion, or jewelry. Check to see whether the user is touching the trackpad simultaneously with both hands.With the computer off, clean the trackpad surface using a clean, dry, lint-free cloth.In System Preferences > Accessibility/Universal Access, disable all assisted “Keyboard” and “Mouse & Trackpad” settings. Retest trackpad functionality.In System Preferences > Trackpad, check and adjust Click pressure and Trackpad speed. Too-high or too-low settings may be perceived as trackpad issues.Disconnect all Bluetooth devices. In System Preferences > Bluetooth, click the ‘X’ button next to every device.If the issue occurs when the computer is running from a power adapter, try using a three-prong power cable rather than a two-prong duckhead.If the issue persists with a three-prong power cable, refer to HT203146: Troubleshooting unresponsive trackpad issues for further instructions.

Deep Dive

	Check	Result	Action	Code	Commodity
1.	The keyboard and trackpad are both controlled by an IPD board located on the trackpad. Failures in both components may indicate an issue with this board.	Yes	Go to step 2.	<code>\$(nodeText.yesSymptomCode)</code>	
	Verify that the keyboard on the computer is functioning and responding to key presses. Is the keyboard functioning properly?	No	Go to step 6.	<code>\$(nodeText.noSymptomCode)</code>	

	Check	Result	Action	Code	Commodity
2.	Run AST 2 Trackpad diagnostic suite.	Yes	Go to step 3.	`\${nodeText.yesSymptomCode}`	
	<p>The diagnostic is Multi-Touch capable and will instruct you to touch every part of the trackpad surface to verify its Multi-Touch functionality.</p> <p>Does the computer pass Trackpad diagnostic suite?</p>	No	Go to step 6.	`\${nodeText.noSymptomCode}`	
3.	Use one of the following two methods to start up the computer to a known-good macOS.	Yes	Go to step 4.	`\${nodeText.yesSymptomCode}`	
	<p>Start up the computer to macOS Recovery. See HT201314: About macOS Recovery.</p> <p>Follow steps in HT208198: About Startup Security Utility to enable starting up from an external storage device on the user's computer. Then start up the computer to a known-good external macOS startup volume.</p> <p>Attempt to reproduce the trackpad issue.</p> <p>Does the issue persist with known-good macOS?</p>	No	<p>Reinstall macOS on the user's computer.</p> <p>Check for and apply the latest software and firmware updates.</p> <p>Verify that the issue is resolved.</p>	`\${nodeText.noSymptomCode}`	
4.	Instead of a standard button, this trackpad uses a force sensor to sense clicks, and a linear actuator to simulate the feeling of a click.	Yes	Go to step 5.	`\${nodeText.yesSymptomCode}`	
	<p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of these components, as well as to recalibrate them if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Important: The calibration check is a very sensitive diagnostic. It requires the use of 200 g and 800 g weights, and must be run on a very stable, flat, and undisturbed work surface. Disruptions to the work surface or misplacement of the weights may cause failures or incorrectly calibrate the trackpad.</p> <p>If the computer fails diagnostic on the first try, it is a good idea to run the diagnostic again after verifying proper weight placement, and that there is no disturbance to the work surface.</p> <p>Does the computer pass Trackpad Calibration Check suite?</p>	No	Go to step 6.	`\${nodeText.noSymptomCode}`	

	Check	Result	Action	Code	Commodity
5.	<p>After running Trackpad Calibration Check suite, verify the functionality of the trackpad, since recalibration may have occurred.</p> <p>Is the trackpad functioning properly?</p>	Yes	Issue resolved. Verify resolution.	\${nodeText.yesSymptomCode}	
		No	<p>ESCALATION REQUIRED.</p> <p>If you suspect a problem even though the computer passed all trackpad diagnostics, contact ACS for additional support.</p>	K99	
6.	<p>Disconnect the IPD flex cable from the logic board, keyboard, and trackpad.</p> <p>Check for damage on the IPD flex cable, its connectors, and the trackpad, keyboard, and logic board IPD flex connectors.</p> <p>Inspect connector housings. Look for debris or broken/missing pins that might prevent proper seating.</p> <p>Is there damage to any flex cable or connector?</p>	Yes	Go to step 7.	\${nodeText.yesSymptomCode}	
		No	Go to step 12.	\${nodeText.noSymptomCode}	
7.	<p>Determine whether damage is limited to one of the following components, or multiple parts are damaged:</p> <ul style="list-style-type: none"> • IPD flex cable • Trackpad • Keyboard (part of top case) • logic board <p>Is there damage to multiple parts?</p>	Yes	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	X99	
		No	Go to step 8.	\${nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
8.	<p>Inspect the IPD flex cable for damage. Pay attention to the body of the cable, looking for pinching, tearing, or crimping, and all ends of the cable.</p> <p>Does the IPD flex cable appear damaged?</p>	Yes	<p>Replace the IPD flex cable.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>	X03	INTERNAL CABLE
		No	Go to step 9.	\${nodeText.noSymptomCode}	
9.	<p>Inspect the trackpad IPD flex cable connector for damage.</p> <p>Does the trackpad IPD flex cable connector appear damaged?</p>	Yes	<p>Replace the trackpad.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>	K16	MOUSE
		No	Go to step 10.	\${nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
10.	<p>Inspect the keyboard IPD flex cable connector for damage.</p> <p>Does the keyboard IPD flex cable connector appear damaged?</p>	Yes	<p>Replace the top case assembly.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	K16	KEYBOARD
		No	Go to step 11.	\${nodeText.noSymptomCode}	
11.	<p>Inspect the logic board IPD flex cable connector for damage.</p> <p>Does the logic board IPD flex cable connector appear damaged?</p>	Yes	<p>Replace the logic board and Touch ID board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M24	MLB
		No	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	X99	

	Check	Result	Action	Code	Commodity
12.	<p>Reconnect the IPD flex cable to the keyboard, ensuring a good connection to the keyboard.</p> <p>Reconnect the IPD flex cable to the logic board and trackpad, ensuring a good connection to both ends.</p> <p>Run AST 2 Trackpad diagnostic suite.</p> <p>Verify functionality of the trackpad and keyboard.</p> <p>Is the trackpad functioning properly?</p>	Yes	<p>Issue resolved by reseating IPD flex cable.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>	\$(nodeText.yesSymptomCode)	
		No	Go to step 13.	\$(nodeText.noSymptomCode)	
13.	<p>Troubleshooting this issue completely requires a known-good IPD flex cable.</p> <p>Do you have immediate access to a known-good IPD flex cable?</p>	Yes	Go to step 14.	\$(nodeText.yesSymptomCode)	
		No	<p>Replace the IPD flex cable.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>	X03	INTERNAL CABLE
14.	<p>Substitute a known-good IPD flex cable.</p> <p>Run AST 2 Trackpad diagnostic suite.</p> <p>Verify functionality of the trackpad and keyboard.</p> <p>Is the trackpad functioning properly?</p>	Yes	<p>Replace the IPD flex cable.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>	X03	INTERNAL CABLE
		No	Go to step 15.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
15.	Troubleshooting this issue completely requires a known-good trackpad.	Yes	Go to step 16.	\${nodeText.yesSymptomCode}	
	Do you have immediate access to a known-good trackpad?	No	Go to step 17.	\${nodeText.noSymptomCode}	
16.	<p>Substitute a known-good trackpad.</p> <p>Run AST 2 Trackpad diagnostic suite.</p> <p>Verify functionality of the trackpad and keyboard.</p> <p>Is the trackpad functioning properly?</p>	Yes	Go to step 17.	\${nodeText.yesSymptomCode}	
		No	<p>Reinstall the user's trackpad.</p> <p>Replace the logic board and Touch ID board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M16	MLB
17.	<p>Check the diagnostic results from Trackpad Calibration Check suite.</p> <p>Look for failures indicated with the actuator.</p> <p>Did the actuator fail Trackpad Calibration Check suite?</p>	Yes	<p>Replace the trackpad.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>	K29	MOUSE
		No	Go to step 18.	\${nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
18.	<p>Isolate the original symptom for this issue as:</p> <ul style="list-style-type: none"> Trackpad has Haptic feedback issues. <p>Does this symptom best describe the original issue?</p>	Yes	<p>Replace the trackpad.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>	K29	MOUSE
		No	Go to step 19.	\$(nodeText.noSymptomCode)	
19.	<p>Isolate the original symptom for this issue as:</p> <ul style="list-style-type: none"> Trackpad click not recognized. <p>Does this symptom best describe the original issue?</p>	Yes	<p>Replace the trackpad.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>	K13	MOUSE
		No	Go to step 20.	\$(nodeText.noSymptomCode)	
20.	<p>Isolate the original symptom for this issue as:</p> <ul style="list-style-type: none"> Trackpad requires high click force. <p>Does this symptom best describe the original issue?</p>	Yes	<p>Replace the trackpad.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>	K24	MOUSE
		No	Go to step 21.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
21.	Isolate the original symptom for this issue as: <ul style="list-style-type: none"> Trackpad is too sensitive to clicks. Does this symptom best describe the original issue?	Yes	Replace the trackpad. Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary. Refer to TP1314: Trackpad Calibration Check for instructions. Verify that the issue is resolved.	K25	MOUSE
		No	Go to step 22.	\$_{nodeText.noSymptomCode}	
22.	Isolate the original symptom for this issue as: <ul style="list-style-type: none"> Multi-Touch gesture issues. Does this symptom best describe the original issue?	Yes	Replace the trackpad. Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary. Refer to TP1314: Trackpad Calibration Check for instructions. Verify that the issue is resolved.	K18	MOUSE
		No	Go to step 23.	\$_{nodeText.noSymptomCode}	
23.	Isolate the original symptom for this issue as: <ul style="list-style-type: none"> Trackpad cursor does not respond. Does this symptom best describe the original issue?	Yes	Replace the trackpad. Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary. Refer to TP1314: Trackpad Calibration Check for instructions. Verify that the issue is resolved.	K23	MOUSE
		No	Go to step 24.	\$_{nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
24.	<p>Isolate the original symptom for this issue as:</p> <ul style="list-style-type: none"> Trackpad cursor not tracking properly. <p>Does this symptom best describe the original issue?</p>	Yes	<p>Replace the trackpad.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>	K12	MOUSE
		No	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	X99	
25.	<p>Check trackpad functionality, including Multi-Touch, click, secondary click, and Force click. Also check keyboard functionality.</p> <p>For full verification, run the following AST 2 diagnostics suites:</p> <ul style="list-style-type: none"> Trackpad (Multi-Touch surface test) Trackpad Calibration Check Keyboard <p>Run AST 2 Full System diagnostic suites (EFI & OS), if available, to ensure no other issues remain.</p> <p>Is the issue resolved?</p>	Yes	The issue is resolved. Verify resolution.	\${nodeText.yesSymptomCode}	
		No	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	X99	

Camera Issues

Unlikely causes:

AC wall adapter (duckhead), audio board, audio board flex cable, battery, bottom case, fan, I/O board, IPD flex cable, power adapter, speakers, top case assembly, Touch ID board, trackpad, USB-C charging cable, vent / antenna module.

Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none">• Camera not detected• No green LED for camera• Excessive blooming in camera image• Poor white balance• Poor focus• Distorted/discolored image• Failure to respond to changing ambient light conditions <p>Note: Inform user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options. Refer to OP14: Determining and quoting accidental damage for Mac portables.</p>	<p>Important: Disable Auto Boot before performing any troubleshooting steps that require disassembly of the computer, and reenable Auto Boot after the computer has been reassembled and service is completed. Follow steps in TP1484: Auto Boot to enable or disable this function.</p> <ol style="list-style-type: none">1. Check for and apply latest software and firmware updates.2. Check HT201260: How to find the macOS version number on your Mac to verify system build is correct for this computer model.3. Verify camera lens and glass panel are clear of contaminants.4. Ask user about lighting conditions in working environment. Dim lighting causes poor image quality. Overly bright lighting can bounce off surfaces onto subject and make image foggy.5. Striped, textured, and mesh clothing can create moiré patterns in image.6. Reset SMC using procedure for this computer in HT201295: How to reset the System Management Controller (SMC) on your Mac.7. Reset the NVRAM using the procedure for this computer in HT204063: Reset NVRAM or PRAM on your Mac.8. Disconnect all peripheral devices and restart computer.

Deep Dive

	Check	Result	Action	Code	Commodity
1.	Run Mac Resource Inspector diagnostic suite (MRI) and check test results to verify camera and display presence.	Yes	Go to step 3.	\$(nodeText.yesSymptomCode)	
	Does MRI detect camera and display?	No	Go to step 2.	\$(nodeText.noSymptomCode)	
2.	Look in System Information > Hardware > Camera, and verify “FaceTime HD Camera” is listed.	Yes	Go to step 3.	\$(nodeText.yesSymptomCode)	
	Does camera appear in System Information?	No	Go to step 5.	\$(nodeText.noSymptomCode)	
3.	Open Photo Booth. Verify green LED next to camera lights up. Make sure image looks normal.	Yes	Go to step 4.	\$(nodeText.yesSymptomCode)	
	Does camera LED light up and does image appear normal?	No	Go to step 5.	\$(nodeText.noSymptomCode)	
4.	Verify that the camera image is clear and undistorted.	Yes	The issue cannot be duplicated.	\$(nodeText.yesSymptomCode)	
	Is the image clear?	No	Go to step 6.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
5.	<p>Follow steps in HT208198: About Startup Security Utility to enable starting up from an external storage device on the user's computer.</p> <p>Start up the computer to a known-good external macOS startup volume.</p> <p>Retest for camera issue.</p> <p>Does the issue persist with known-good macOS?</p>	Yes	Go to step 6.	\$(nodeText.yesSymptomCode)	
		No	<p>Reinstall macOS on the user's computer.</p> <p>Check for and apply the latest software and firmware updates.</p> <p>Verify resolution.</p>	\$(nodeText.noSymptomCode)	
6.	<p>Follow Service Guide procedures to remove the bottom case and disconnect the battery from the logic board.</p> <p>Disconnect and inspect the TCON flex cable for damage. Look for pinching or crimping, and damaged or bent pins.</p> <p>Does the TCON flex cable show signs of damage?</p>	Yes	Go to step 7.	\$(nodeText.yesSymptomCode)	
		No	Go to step 8.	\$(nodeText.noSymptomCode)	
7.	<p>Inspect the logic board and display TCON flex connectors for damage.</p> <p>Is the connector on the logic board or display also damaged?</p>	Yes	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	X99	
		No	<p>Replace the TCON flex cable.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>	X03	INTERNAL CABLE

	Check	Result	Action	Code	Commodity
8.	<p>Inspect the logic board TCON connector for damage.</p> <p>Does the connector on the logic board show signs of damage?</p>	Yes	<p>Replace the logic board and Touch ID board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M24	MLB
		No	Go to step 9.	\$(nodeText.noSymptomCode)	
9.	<p>Inspect the display TCON connector for damage.</p> <p>Does the connector on the display show signs of damage?</p>	Yes	<p>Replace the display assembly.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	L14	LCD
		No	Go to step 10.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
10.	<p>Reseat the TCON flex cable connectors on the logic board and display. Reseating the cable can restore camera functionality.</p> <p>Reassemble the computer and retest for camera functionality.</p> <p>An NVRAM reset may be required if the brightness was lowered during troubleshooting.</p> <p>Is camera functionality restored?</p>	Yes	<p>The issue was resolved by reseating the TCON flex cable.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>	\${nodeText.yesSymptomCode}	
		No	Go to step 11.	\${nodeText.noSymptomCode}	
11.	<p>Troubleshooting this issue completely requires a known-good TCON flex cable.</p> <p>Do you have immediate access to a known-good TCON flex cable?</p>	Yes	Go to step 12.	\${nodeText.yesSymptomCode}	INTERNAL CABLE
		No	<p>Replace the TCON flex cable.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>		

	Check	Result	Action	Code	Commodity
12.	<p>Substitute a known-good TCON flex cable and retest for camera functionality.</p> <p>Is camera functionality restored?</p>	Yes	<p>Replace the TCON flex cable.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>	X03	INTERNAL CABLE
		No	Go to step 13.	\$(nodeText.noSymptomCode)	
13.	<p>Reinstall the user's TCON flex cable.</p> <p>Troubleshooting this issue completely requires a known-good display assembly.</p> <p>Do you have immediate access to a known-good display assembly?</p>	Yes	Go to step 14.	\$(nodeText.yesSymptomCode)	
		No	<p>Replace the display assembly.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	L17	LCD

	Check	Result	Action	Code	Commodity
14.	<p>Substitute a known-good display assembly and retest for camera functionality.</p> <p>Is camera functionality restored?</p>	Yes	<p>Replace the display assembly.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	L17	LCD
		No	<p>Reinstall the user's display assembly.</p> <p>Replace the logic board and Touch ID board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M13	MLB
15.	<p>Verify that camera now functions as expected and that image quality is normal.</p> <p>Run AST 2 Full System diagnostic suites (EFI & OS), if available, to ensure no other issues remain.</p> <p>Is issue resolved?</p>	Yes	Issue resolved.	`\${nodeText.yesSymptomCode}`	
		No	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	L99	

Distorted Audio from Internal Speakers

Unlikely causes:

AC wall adapter (duckhead), battery, bottom case, display assembly, fan, I/O board, IPD flex cable, power adapter, TCON flex cable, top case assembly, Touch ID board, trackpad, USB-C charging cable, vent / antenna module.

Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none">• Sound is distorted, fuzzy, or crackly• Symptom only occurs with internal speakers• Symptom only occurs with external speakers or headphones <p>Note: Inform the user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options. Refer to OP14: Determining and quoting accidental damage for Mac portables.</p>	<p>Important: Disable Auto Boot before performing any troubleshooting steps that require disassembly of the computer, and reenable Auto Boot after the computer has been reassembled and service is completed. Follow steps in TP1484: Auto Boot to enable or disable this function.</p> <ol style="list-style-type: none">1. Test with a known-good sound file.2. Compare the same sound and settings against a known-good computer of the same type to confirm that the sound is distorting.3. In System Preferences > Sound > Output, adjust the Output volume and use the balance slider to isolate the left and right speakers.4. Reset the NVRAM using the procedure for this computer in HT204063: Reset NVRAM or PRAM on your Mac.5. If testing using iTunes, check that the equalizer is not turned on.6. Test the audio output using more than one application or website.7. Refer to HT201260: How to find the macOS version number on your Mac to check that the system build is correct for this computer model. Check for and apply the latest software and firmware updates.

Deep Dive

	Check	Result	Action	Code	Commodity
1.	Follow steps in HT208198: About Startup Security Utility to enable starting up from an external storage device on the user's computer.	Yes	Go to step 2.	`\${nodeText.yesSymptomCode}`	
	Start up the computer to a known-good external macOS startup volume. Attempt to reproduce the audio issue. Does the issue persist with known-good macOS?	No	Reinstall macOS on the user's computer. Check for and apply the latest software and firmware updates. Verify that the issue is resolved.	`\${nodeText.noSymptomCode}`	

	Check	Result	Action	Code	Commodity
2.	Reset the NVRAM using the procedure for this computer in HT204063: Reset NVRAM or PRAM on your Mac .	Yes	Issue resolved. Verify resolution.	`\${nodeText.yesSymptomCode}`	
	In System Preferences > Sound > Output, adjust Output volume and retest. Play audio through internal speakers and known-good headphones or external speakers. Is audio clear and distortion free through internal speakers and headphones/external speakers?	No	Go to step 3.	`\${nodeText.noSymptomCode}`	
3.	Play a known-good audio file on internal speakers, then connect known-good headphones or external speakers and compare for distortion.	Yes	Go to step 4.	`\${nodeText.yesSymptomCode}`	
	Is the issue isolated to the internal speakers?	No	Go to step 5.	`\${nodeText.noSymptomCode}`	
4.	Disconnect headphones/external speakers.	Yes	Issue resolved. Verify resolution.	`\${nodeText.yesSymptomCode}`	
	Run AST 2 Audio Test suite to verify that left and right speakers produce expected audio test patterns from each speaker. Refer to TP587: Using Audio Test . Does computer pass AST 2 Audio Test suite?	No	Go to step 10.	`\${nodeText.noSymptomCode}`	
5.	Inspect and reseal audio board flex cable connectors.	Yes	Go to step 6.	`\${nodeText.yesSymptomCode}`	
	Inspect cables and connectors for damage. Check audio board and logic board connectors for missing or bent pins that might prevent correct seating. Is damage found on logic board or audio board connectors, or the flex cable?	No	Go to step 7.	`\${nodeText.noSymptomCode}`	

	Check	Result	Action	Code	Commodity
6.	<p>Determine whether there is damage to the audio board, its flex cable, the logic board, or to a combination of multiple components.</p> <p>Is the damage limited to the audio board flex cable?</p>	Yes	<p>Replace the audio board flex cable.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>	X03	OTHER ELECTRIC
		No	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	X99	
7.	<p>Use known-good headphones or external speakers to test the output from the external audio port. Verify you can hear audio that is clear and distortion free.</p> <p>Is audio through headphones or external speakers clear and distortion free?</p>	Yes	<p>The issue was resolved by reseating the audio board flex cable.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>	<p>\$(nodeText.yesSymptomCode)</p>	
		No	Go to step 8.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
8.	<p>Troubleshooting this issue completely requires a known-good audio board.</p> <p>Do you have immediate access to a known-good audio board?</p>	Yes	Go to step 9.	\${nodeText.yesSymptomCode}	
		No	<p>Replace the audio board.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>	M09	OTHER BOARD

	Check	Result	Action	Code	Commodity
9.	<p>Substitute a known-good audio board. Use known-good headphones or external speakers to test the output from the external audio port. Verify you can hear audio that is clear and distortion free.</p> <p>Run AST 2 Audio Test suite to verify that left and right speakers produce expected audio test patterns from each speaker.</p> <p>Refer to TP587: Using Audio Test.</p> <p>Is the issue resolved by the known-good audio board?</p>	Yes	<p>Replace the audio board.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>	M09	OTHER BOARD
		No	<p>Replace the logic board and Touch ID board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M09	MLB
10.	<p>In System Preferences > Sound > Output, move Balance slider all the way left, then all the way right, testing audio each time. Test full range of volume settings.</p> <p>Is distortion audible on one speaker or both internal speakers?</p>	Both Speakers	Go to step 11.	`\${nodeText.yesSymptomCode}`	
		Only One Speaker	Go to step 14.	`\${nodeText.noSymptomCode}`	

	Check	Result	Action	Code	Commodity
11.	Inspect and reseal left and right speaker connections to logic board.	Yes	Go to step 12.	`\${nodeText.yesSymptomCode}`	
	Check speaker wire and connectors for damage. Check logic board connector for missing or bent pins that might prevent correct seating.	No	Go to step 13.	`\${nodeText.noSymptomCode}`	
	Is damage found on logic board connectors or wired speakers?				
12.	Determine whether damage is on the logic board, speakers, or both.	Yes	Speakers are replaced as a matched set. Replace speakers with a matched-pair replacement kit. Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary. Refer to TP1314: Trackpad Calibration Check for instructions. Verify that the issue is resolved.	X03	OTHER ELECTRIC
	Is the damage limited to speakers?	No	ESCALATION REQUIRED. Contact ACS for additional support or a multipart repair.	X99	
13.	With speakers reseated to logic board, play audio through internal speakers.	Yes	Issue resolved by cleaning speakers or reseating speaker connections. Verify resolution.	`\${nodeText.yesSymptomCode}`	
	Is audio through internal speakers clear and distortion free?	No	Go to step 19.	`\${nodeText.noSymptomCode}`	
14.	Audio distortion only appears to come from one speaker. Identify which speaker is affected.	Left Speaker	Go to step 15.	`\${nodeText.yesSymptomCode}`	
	Which speaker is affected by sound distortion?	No	Go to step 17.	`\${nodeText.noSymptomCode}`	

	Check	Result	Action	Code	Commodity
15.	Inspect left speaker cable connector and its corresponding connector on logic board. Reseat connector and retest.	Yes	Issue resolved. Verify resolution.	\$(nodeText.yesSymptomCode)	
	Is audio through left speaker clear and distortion free?	No	Go to step 16.	\$(nodeText.noSymptomCode)	
16.	Inspect and carefully clean speaker cone using a soft tissue to remove dust, debris, and foreign material, such as metal fragments that easily adhere to magnetic speakers. Reseat speaker connector and retest.	Yes	Issue resolved by cleaning speakers or reseating speaker connections. Verify resolution.	\$(nodeText.yesSymptomCode)	
	Is audio through left speaker clear and distortion free?	No	Go to step 19.	\$(nodeText.noSymptomCode)	
17.	Inspect right speaker cable connector and its corresponding connector on logic board. Reseat connector and retest.	Yes	Issue resolved. Verify resolution.	\$(nodeText.yesSymptomCode)	
	Is audio through right speaker clear and distortion free?	No	Go to step 18.	\$(nodeText.noSymptomCode)	
18.	Inspect and carefully clean speaker cone using a soft tissue to remove dust, debris, and foreign material, such as metal fragments that easily adhere to magnetic speakers. Reseat speaker connector and retest.	Yes	Issue resolved. Verify resolution.	\$(nodeText.yesSymptomCode)	
	Is audio through right speaker clear and distortion free?	No	Go to step 19.	\$(nodeText.noSymptomCode)	
19.	<p>Troubleshooting this issue completely requires a known-good left/right speaker set.</p> <p>Do you have immediate access to a known-good left/right speaker set.</p>	Yes	Go to step 20.	\$(nodeText.yesSymptomCode)	
		No	<p>Speakers are replaced as a matched set. Replace speakers with a matched-pair replacement kit.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>	X09	OTHER ELECTRIC

	Check	Result	Action	Code	Commodity
20.	<p>Substitute a known-good left/right speaker set and verify you can hear audio through internal speakers that is clear and distortion free.</p> <p>Run AST 2 Audio Test suite to verify that left and right speakers produce expected audio test patterns from each speaker.</p> <p>Refer to TP587: Using Audio Test.</p> <p>Does computer pass AST 2 Audio Test suite?</p>	Yes	<p>Speakers are replaced as a matched set. Replace speakers with a matched-pair replacement kit.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>	X09	OTHER ELECTRIC
		No	<p>Reinstall the user's left/right speaker set.</p> <p>Replace the logic board and Touch ID board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M09	MLB

	Check	Result	Action	Code	Commodity
21.	Connect and disconnect headphones/external speakers. Verify that audio through both internal speakers and headphones/external speakers is clear and distortion free.	Yes	Issue resolved.	\${nodeText.yesSymptomCode}	
	Run AST 2 Full System diagnostic suites (EFI & OS), if available, to ensure no other issues remain.	No	ESCALATION REQUIRED. Contact ACS for additional support or a multipart repair.	X99	
	Is issue resolved?				

External Apple Bluetooth Peripherals

Unlikely causes:

There are no unlikely causes for this issue.

Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none"> Apple Bluetooth wireless keyboard, mouse, or trackpad is not recognized by known-good computer Apple Bluetooth wireless keyboard, mouse, or trackpad will not pair with known-good computer Apple Bluetooth wireless keyboard, mouse, or trackpad intermittently loses its connection Apple wireless keyboard has one or more of the following issues: <ul style="list-style-type: none"> No power Battery will not charge (for peripherals with embedded batteries) Swollen battery (for peripherals with embedded batteries) Battery runtime too short Will not turn off One or more keys do not work Keys seem to stick, do not respond properly, or respond slowly Wrong keyboard language Keys missing or falling off Paint wearing off of one or more keys Physical and/or cosmetic issues Apple wireless mouse has one or more of the following issues: <ul style="list-style-type: none"> No power Battery will not charge (for peripherals with embedded batteries) Swollen battery (for peripherals with embedded batteries) Battery runtime too short Will not turn off No mouse response Mouse click not recognized Mouse causes erratic cursor tracking Physical and/or cosmetic issues Apple wireless trackpad has one or more of the following issues: <ul style="list-style-type: none"> No power Battery will not charge (for peripherals with embedded batteries) Swollen battery (for peripherals with embedded batteries) Battery runtime too short Will not turn off No trackpad response Trackpad click not recognized Trackpad causes erratic cursor tracking Trackpad requires high click force Trackpad click overly sensitive Force Touch or haptic feedback issue Physical and/or cosmetic issues <p>Note: Inform user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	<p>Important: This troubleshooting procedure is intended only for Apple Bluetooth wireless peripheral devices, such as the following Apple products:</p> <ul style="list-style-type: none"> Magic Mouse or Magic Mouse 2 Magic Trackpad or Magic Trackpad 2 Apple Wireless Keyboard or Magic Keyboard <p>For simplicity, this procedure refers to these products as wireless mouse, wireless trackpad, and wireless keyboard unless otherwise noted.</p> <p>For third-party devices, contact the manufacturer for support, software/firmware updates, or service options.</p> <ol style="list-style-type: none"> Verify compatibility of the user's Apple wireless mouse, keyboard, or trackpad. Refer to HT201806: How to identify your Apple wireless mouse, keyboard, or trackpad. Check for and apply the latest software and firmware updates. In System Preferences, make sure Bluetooth is on and set to Discoverable. For Apple Bluetooth peripherals with replaceable batteries, such as Magic Mouse, Magic Trackpad, or Apple Wireless Keyboard: If the device does not turn on, then install new or fully charged batteries. For Apple Bluetooth peripherals with embedded batteries, such as Magic Mouse 2, Magic Trackpad 2, or Magic Keyboard: If the device does not turn on, then connect a known-good USB Power Adapter and Lightning cable to the device to charge it for at least two minutes. Switching the device on/off button or switch to the on position will allow the device to charge more quickly than when off. For Apple Bluetooth peripherals with embedded batteries such as Magic Mouse 2, Magic Trackpad 2, or Magic Keyboard, verify that the computer being used with the peripheral supports Bluetooth 4.0 or later. Computers with earlier versions of Bluetooth support will not pair with Apple Bluetooth peripherals with embedded batteries. Reset Bluetooth device or delete pairing (if applicable). If Bluetooth pairs normally at your service location, then research potential sources of interference in the user's environment, such as microwave ovens or cordless phones in the 2.4/5GHz range. See article HT201542: Potential sources of Wi-Fi and Bluetooth interference. Magic Mouse 2, Magic Trackpad 2, and Magic Keyboard can pair with the computer using either Bluetooth or a Lightning cable. If Bluetooth pairing is not possible due to interference or other reasons, then try pairing these products by connecting them to the known-good computer with a known-good Lightning cable. Refer to HT201178: Set up your Apple wireless mouse, keyboard, and trackpad. For keyboard issues, refer to HT204540: If your Apple keyboard doesn't work and HT203162: One or more keys on the keyboard do not respond for troubleshooting tips.

Deep Dive

	Check	Result	Action	Code	Commodity
1.	<p>Visually inspect the user's wireless mouse, wireless trackpad, or wireless keyboard for any physical, cosmetic, and liquid damage.</p> <p>On a wireless mouse or wireless trackpad, verify that the mouse or trackpad button clicks.</p> <p>On keyboards, verify that all keyboard buttons are present and can be depressed normally.</p> <p>Does the user's wireless mouse, wireless trackpad, or wireless keyboard show signs of damage?</p>	Yes	Go to step 2.	\$(nodeText.yesSymptomCode}	
		No	Go to step 11.	\$(nodeText.noSymptomCode}	
2.	<p>Determine whether there is a safety issue, such as fumes, excessive heat, or shock.</p> <p>Do not perform procedures that can be a safety risk to you or the user.</p> <p>Can you proceed safely?</p>	Yes	Go to step 3.	\$(nodeText.yesSymptomCode}	
		No	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support regarding safety procedures for this product.</p>	\$(nodeText.noSymptomCode}	
3.	<p>Isolate damage issue to either user's wireless keyboard or wireless mouse or trackpad.</p> <p>Which peripheral is damaged?</p>	Wireless keyboard	Go to step 4.	\$(nodeText.yesSymptomCode}	
		Wireless mouse or trackpad	Go to step 8.	\$(nodeText.noSymptomCode}	
4.	<p>Closely examine the user's device to determine exact nature of the issue.</p> <p>Look for any signs of liquid spill, liquid penetration, or liquid damage to device.</p> <p>Is damage to user's device related to liquid spill?</p>	Yes	Replace the user's wireless keyboard out of warranty.	K90	KEYBOARD
		No	Go to step 5.	\$(nodeText.noSymptomCode}	
5.	<p>Closely examine the user's device for any signs of physical damage that may affect operation.</p> <p>Does the user's device exhibit this symptom?</p>	Yes	Replace the user's wireless keyboard out of warranty.	K16	KEYBOARD
		No	Go to step 6.	\$(nodeText.noSymptomCode}	
6.	<p>Closely examine the user's device for signs of paint wearing off of one or more keys.</p> <p>Does the user's device exhibit this symptom?</p>	Yes	Replace the user's wireless keyboard out of warranty.	K35	KEYBOARD
		No	Go to step 7.	\$(nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
7.	Closely examine the user's device for any signs of cosmetic damage that does not affect operation.	Yes	Replace the user's wireless keyboard out of warranty.	K21	KEYBOARD
	Does the user's device exhibit this symptom?	No	Issue cannot be duplicated.	\$(nodeText.noSymptomCode)	
8.	Closely examine the user's device to determine exact nature of the issue.	Yes	Replace the user's wireless mouse or wireless trackpad out of warranty.	K90	MOUSE
	Look for any signs of liquid spill, liquid penetration, or liquid damage to device.	No	Go to step 9.	\$(nodeText.noSymptomCode)	
	Is damage to user's device related to liquid spill?				
9.	Closely examine the user's device for any signs of physical damage that may affect operation.	Yes	Replace the user's wireless mouse or wireless trackpad out of warranty.	K16	MOUSE
	Does the user's device exhibit this symptom?	No	Go to step 10.	\$(nodeText.noSymptomCode)	
10.	Closely examine the user's device for any signs of cosmetic damage that does not affect operation.	Yes	Replace the user's wireless mouse or wireless trackpad out of warranty.	K21	MOUSE
	Does the user's device exhibit this symptom?	No	Issue cannot be duplicated.	\$(nodeText.noSymptomCode)	
11.	Follow steps listed in HT201171: Using a Bluetooth mouse, keyboard, or trackpad with your Mac to pair the user's Bluetooth device with a known-good Mac.	Yes	ESCALATION REQUIRED. The Bluetooth device appears to be performing to specifications. There may be an issue with the user's computer, or wireless interference in user's environment. If issue persists, then contact ACS for additional support.	\$(nodeText.yesSymptomCode)	
	Test the user's wireless mouse, wireless trackpad, or wireless keyboard manually, using built-in applications on a known-good Mac. For example, use the Notes application to check the keys on a wireless keyboard.				
	Refer to HT204621: If your Apple wireless mouse, keyboard, or trackpad aren't working as expected for tips to resolve issues.				
12.	Does the user's wireless mouse, wireless trackpad, or wireless keyboard pair and function normally?	No	Go to step 12.	\$(nodeText.noSymptomCode)	
	Isolate failure to either user's wireless keyboard or wireless mouse or trackpad.	Wireless keyboard	Go to step 13.	\$(nodeText.yesSymptomCode)	
	Which peripheral is malfunctioning?	Wireless mouse or trackpad	Go to step 29.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
13.	Look for for any signs of power on the user's wireless keyboard, such as a power LED turning on. Note: Not all devices have a power LED.	Yes	Go to step 14.	\$(nodeText.yesSymptomCode)	
	Verify that the user's wireless keyboard turns ON when the on/off button or switch is placed in the on position. Verify that the user's wireless keyboard turns off when the on/off button or switch is placed in the off position. Does the user's wireless keyboard exhibit any power-related symptoms?	No	Go to step 18.	\$(nodeText.noSymptomCode)	
14.	Confirm that the issue with the user's wireless keyboard is: <ul style="list-style-type: none"> User's wireless keyboard is not functioning at all (seems dead, no power, power LED does not turn on) 	Yes	Replace the user's wireless keyboard. Verify that the issue is resolved.	K09	KEYBOARD
	Does the user's wireless keyboard exhibit this symptom?	No	Go to step 15.	\$(nodeText.noSymptomCode)	
15.	Verify that the user's wireless keyboard turns on when the on/off button or switch is placed in the on position. Confirm that the issue with the user's wireless keyboard is: <ul style="list-style-type: none"> On/off switch or button is defective 	Yes	Replace the user's wireless keyboard. Verify that the issue is resolved.	K19	KEYBOARD
	Does the user's wireless keyboard exhibit this symptom?	No	Go to step 16.	\$(nodeText.noSymptomCode)	
16.	Verify that the user's wireless keyboard turns off when the on/off button or switch is placed in the off position. Confirm that the issue with the user's wireless keyboard is: <ul style="list-style-type: none"> User's wireless keyboard remains on when the on/off button or switch has been placed in the off position 	Yes	Replace the user's wireless keyboard. Verify that the issue is resolved.	K34	KEYBOARD
	Does the user's wireless keyboard exhibit this symptom?	No	Go to step 17.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
17.	Verify if the user's wireless keyboard has any other power-related issue that is not related to the on/off button or switch.	Yes	Replace the user's wireless keyboard. Verify that the issue is resolved.	K20	KEYBOARD
	Confirm that the issue with the user's wireless keyboard is: <ul style="list-style-type: none"> Power Issue, not due to on/off button or switch Does the user's wireless keyboard exhibit this symptom?	No	Go to step 18.	\$(nodeText.noSymptomCode)	
18.	If the user's issue involves pairing or connecting to a Magic Keyboard, then you can connect to, pair, and use this device with the computer using either Bluetooth or a Lightning cable.	Yes	Go to step 19.	\$(nodeText.yesSymptomCode)	
	If Bluetooth pairing is not possible due to interference or other reasons, then try connecting the user's Magic Keyboard to the known-good computer with a known-good Lightning cable. For other Apple Bluetooth peripherals, select the "Yes" answer to continue. Does the user's Magic Keyboard connect and pair using USB?	No	Replace the user's wireless keyboard. Verify that the issue is resolved.	K30	KEYBOARD
19.	Verify that the known-good computer can recognize the user's wireless keyboard.	Yes	Replace the user's wireless keyboard. Verify that the issue is resolved.	K15	KEYBOARD
	Confirm that the issue with the user's wireless keyboard is: <ul style="list-style-type: none"> User's wireless keyboard is not recognized by known-good computer Does the user's wireless keyboard exhibit this symptom?	No	Go to step 20.	\$(nodeText.noSymptomCode)	
20.	Verify that the known-good computer can pair with the user's wireless keyboard using Bluetooth.	Yes	Replace the user's wireless keyboard. Verify that the issue is resolved.	K07	KEYBOARD
	Confirm that the issue with the user's wireless keyboard is: <ul style="list-style-type: none"> User's wireless keyboard cannot pair with a known-good computer Does the user's wireless keyboard exhibit this symptom?	No	Go to step 21.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
21.	Verify that the known-good computer maintains a Bluetooth connection to the user's wireless keyboard, and does not drop this connection.	Yes	Replace the user's wireless keyboard. Verify that the issue is resolved.	K08	KEYBOARD
	Confirm that the issue with the user's wireless keyboard is: <ul style="list-style-type: none"> User's wireless keyboard intermittently loses its connection with a known-good computer Does the user's wireless keyboard exhibit this symptom?	No	Go to step 22.	\$(nodeText.noSymptomCode)	
22.	Ask the user how often and how long the wireless keyboard is used.	Yes	Go to step 23.	\$(nodeText.yesSymptomCode)	
	Explain to the user that the battery issue could likely be caused by the user using the wireless keyboard continuously over a long period of time, rather than any fault of the wireless keyboard itself, macOS, or the user's computer. Gain agreement from the user that lengthy wireless keyboard usage is likely to be the cause of the battery life issue, and that there is no service issue with the wireless keyboard itself. Does the user agree that the battery life issue is likely caused by lengthy wireless keyboard usage?	No	Replace the user's wireless keyboard. Verify that the issue is resolved.	K32	KEYBOARD
23.	Attempt to charge the user's wireless keyboard battery for several more minutes. Verify that the user's wireless keyboard battery charge level that appears on the known-good computer that is paired with this user's wireless keyboard has increased and shows that the user's wireless keyboard is charging.	Yes	Replace the user's wireless keyboard. Verify that the issue is resolved.	K31	KEYBOARD
	Confirm that the issue with the user's wireless keyboard is: <ul style="list-style-type: none"> User's wireless keyboard battery will not charge Note: This symptom does not apply to peripherals with replaceable batteries. Does the user's wireless keyboard exhibit this symptom?	No	Go to step 24.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
24.	Closely inspect the user's wireless keyboard enclosure for signs of a swollen battery.	Yes	Replace the user's wireless keyboard.	K33	KEYBOARD
	Confirm that the issue with the user's wireless keyboard is: <ul style="list-style-type: none"> User's wireless keyboard battery appears swollen <p>Note: This symptom does not apply to peripherals with replaceable batteries.</p> <p>Does the user's wireless keyboard exhibit this symptom?</p>		Verify that the issue is resolved.		
		No	Go to step 25.	\$(nodeText.noSymptomCode)	
25.	Verify that each and every wireless keyboard key functions as expected when pressed and released.	Yes	Replace the user's wireless keyboard.	K01	KEYBOARD
	Confirm that the issue with the user's wireless keyboard is: <ul style="list-style-type: none"> One or more keys do not work <p>Does the user's wireless keyboard exhibit this symptom?</p>		Verify that the issue is resolved.		
		No	Go to step 26.	\$(nodeText.noSymptomCode)	
26.	Verify that each and every wireless keyboard key functions as expected when pressed and released.	Yes	Replace the user's wireless keyboard.	K05	KEYBOARD
	Confirm that the issue with the user's wireless keyboard is: <ul style="list-style-type: none"> Keys seem to stick, do not respond properly, or respond slowly <p>Does the user's wireless keyboard exhibit this symptom?</p>		Verify that the issue is resolved.		
		No	Go to step 27.	\$(nodeText.noSymptomCode)	
27.	Verify that each and every wireless keyboard key is intact and not missing.	Yes	Replace the user's wireless keyboard.	K27	KEYBOARD
	Confirm that the issue with the user's wireless keyboard is: <ul style="list-style-type: none"> Keys missing or falling off <p>Does the user's wireless keyboard exhibit this symptom?</p>		Verify that the issue is resolved.		
		No	Go to step 28.	\$(nodeText.noSymptomCode)	
28.	Verify that the wireless keyboard language is as expected.	Yes	Replace the user's wireless keyboard.	K04	KEYBOARD
	Confirm that the issue with the user's wireless keyboard is: <ul style="list-style-type: none"> Wrong keyboard language version <p>Does the user's wireless keyboard exhibit this symptom?</p>		Verify that the issue is resolved.		
		No	Issue cannot be duplicated.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
29.	Look for for any signs of power on the user's wireless mouse or trackpad, such as a power LED turning on. Note: Not all devices have a power LED.	Yes	Go to step 30.	\$(nodeText.yesSymptomCode}	
	Verify that the user's wireless mouse or trackpad turns on when the on/off button or switch is placed in the on position.	No	Go to step 34.	\$(nodeText.noSymptomCode}	
	Verify that the user's wireless mouse or trackpad turns off when the on/off button or switch is placed in the off position.				
	Does the user's wireless mouse or trackpad exhibit any power-related symptoms?				
30.	Confirm that the issue with the user's wireless mouse or trackpad is:	Yes	Replace the user's wireless mouse or trackpad.	K09	MOUSE
	<ul style="list-style-type: none"> User's wireless mouse or trackpad is not functioning at all (seems dead, no power, power LED does not turn on) 		Verify that the issue is resolved.		
	Does the user's wireless mouse or trackpad exhibit this symptom?	No	Go to step 31.	\$(nodeText.noSymptomCode}	
31.	Verify that the user's wireless mouse or trackpad turns on when the on/off button or switch is placed in the on position.	Yes	Replace the user's wireless mouse or trackpad.	K19	MOUSE
	Confirm that the issue with the user's wireless mouse or trackpad is:		Verify that the issue is resolved.		
	<ul style="list-style-type: none"> on/off switch or button is defective 	No	Go to step 32.	\$(nodeText.noSymptomCode}	
	Does the user's wireless mouse or trackpad exhibit this symptom?				
32.	Verify that the user's wireless mouse or trackpad turns off when the on/off button or switch is placed in the off position.	Yes	Replace the user's wireless mouse or trackpad.	K34	MOUSE
	Confirm that the issue with the user's wireless mouse or trackpad is:		Verify that the issue is resolved.		
	<ul style="list-style-type: none"> User's wireless mouse or trackpad remains on when the on/off button or switch has been placed in the off position 	No	Go to step 33.	\$(nodeText.noSymptomCode}	
	Does the user's wireless mouse or trackpad exhibit this symptom?				

	Check	Result	Action	Code	Commodity
33.	Verify if the user's wireless mouse or trackpad has any other power-related issue that is not related to the on/off button or switch.	Yes	Replace the user's wireless mouse or trackpad. Verify that the issue is resolved.	K20	MOUSE
	Confirm that the issue with the user's wireless mouse or trackpad is: <ul style="list-style-type: none"> • Power Issue, not due to on/off button or switch Does the user's wireless mouse or trackpad exhibit this symptom?	No	Go to step 34.	\$(nodeText.noSymptomCode)	
34.	If the user's issue involves pairing or connecting to a Magic Mouse 2 or Magic Trackpad 2, then you can connect to and pair these devices with a computer using either Bluetooth or a Lightning cable.	Yes	Go to step 35.	\$(nodeText.yesSymptomCode)	
	If Bluetooth pairing is not possible due to interference or other reasons, then try connecting the user's Magic Mouse 2 or Magic Trackpad 2 to a known-good computer with a known-good Lightning cable. For other Apple Bluetooth peripherals, select the "Yes" answer to continue. Does the user's Magic Mouse 2 or Magic Trackpad 2 connect and pair using USB?	No	Replace the user's wireless mouse or trackpad. Verify that the issue is resolved.	K30	MOUSE
35.	Verify that the known-good computer can recognize the user's wireless mouse or trackpad.	Yes	Replace the user's wireless mouse or trackpad. Verify that the issue is resolved.	K15	MOUSE
	Confirm that the issue with the user's wireless mouse or trackpad is: <ul style="list-style-type: none"> • User's wireless mouse or trackpad is not recognized by known-good computer. Does the user's wireless mouse or trackpad exhibit this symptom?	No	Go to step 36.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
36.	Verify that the known-good computer can pair with the user's wireless mouse or trackpad.	Yes	Replace the user's wireless mouse or trackpad. Verify that the issue is resolved.	K07	MOUSE
	Confirm that the issue with the user's wireless mouse or trackpad is: <ul style="list-style-type: none"> User's wireless mouse or trackpad cannot pair with a known-good computer Does the user's wireless mouse or trackpad exhibit this symptom?	No	Go to step 37.	\$(nodeText.noSymptomCode)	
37.	Verify that the known-good computer maintains a Bluetooth connection to the user's wireless mouse or trackpad, and does not drop this connection.	Yes	Replace the user's wireless mouse or trackpad. Verify that the issue is resolved.	K08	MOUSE
	Confirm that the issue with the user's wireless mouse or trackpad is: <ul style="list-style-type: none"> User's wireless mouse or trackpad intermittently loses its connection with a known-good computer Does the user's wireless mouse or trackpad exhibit this symptom?	No	Go to step 38.	\$(nodeText.noSymptomCode)	
38.	Ask the user how often and how long the wireless mouse or trackpad is used.	Yes	Go to step 39.	\$(nodeText.yesSymptomCode)	
	Gain agreement from the user that lengthy wireless mouse or trackpad usage is likely to be the cause of the battery life issue, and that there is no service issue with the wireless mouse or trackpad itself. Does the user agree that the battery life issue is likely caused by lengthy wireless device usage?	No	Replace the user's wireless mouse or trackpad. Verify that the issue is resolved.	K32	MOUSE

	Check	Result	Action	Code	Commodity
39.	Attempt to charge the user's wireless mouse or trackpad battery for several more minutes. Verify that the user's wireless mouse or trackpad battery charge level that appears on the known-good computer that is paired with this user's wireless mouse or trackpad has increased and shows that the user's wireless mouse or trackpad is charging.	Yes	Replace the user's wireless mouse or trackpad. Verify that the issue is resolved.	K31	MOUSE
	Confirm that the issue with the user's wireless mouse or trackpad is: <ul style="list-style-type: none"> User's wireless mouse or trackpad battery will not charge <p>Note: This symptom does not apply to peripherals with replaceable batteries.</p> <p>Does the user's wireless mouse or trackpad exhibit this symptom?</p>	No	Go to step 40.	\$(nodeText.noSymptomCode)	
40.	Closely inspect the user's wireless mouse or trackpad enclosure for signs of a swollen battery.	Yes	Replace the user's wireless mouse or trackpad. Verify that the issue is resolved.	K33	MOUSE
	Confirm that the issue with the user's wireless mouse or trackpad is: <ul style="list-style-type: none"> User's wireless mouse or trackpad battery appears swollen <p>Note: This symptom does not apply to peripherals with replaceable batteries.</p> <p>Does the user's wireless mouse or trackpad exhibit this symptom?</p>	No	Go to step 41.	\$(nodeText.noSymptomCode)	
41.	Isolate failure to either user's wireless mouse or wireless trackpad.	Wireless mouse	Go to step 42.	\$(nodeText.yesSymptomCode)	
	Which peripheral is malfunctioning?	Wireless trackpad	Go to step 45.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
42.	Verify that the overall function of the user's wireless mouse performs as expected when used with the known-good computer.	Yes	Replace the user's wireless mouse. Verify that the issue is resolved.	K26	MOUSE
	Confirm that the issue with the user's wireless mouse is: <ul style="list-style-type: none"> No mouse response Does the user's wireless mouse exhibit this symptom?	No	Go to step 43.	\$(nodeText.noSymptomCode)	
43.	Verify that the clicking function of the user's wireless mouse performs as expected when pressed and released.	Yes	Replace the user's wireless mouse. Verify that the issue is resolved.	K14	MOUSE
	Confirm that the issue with the user's wireless mouse is: <ul style="list-style-type: none"> Mouse clicking function not working properly Does the user's wireless mouse exhibit this symptom?	No	Go to step 44.	\$(nodeText.noSymptomCode)	
44.	Verify that the touch gesture function of the user's wireless mouse performs as expected when the mouse surface is touched.	Yes	Replace the user's wireless mouse. Verify that the issue is resolved.	K18	MOUSE
	Confirm that the issue with the user's wireless mouse is: <ul style="list-style-type: none"> Touch/Multi-Touch gesture issue Does the user's wireless mouse exhibit this symptom?	No	Issue cannot be duplicated.	\$(nodeText.noSymptomCode)	
45.	Verify that the overall function of the user's wireless trackpad performs as expected when used with the known-good computer.	Yes	Replace the user's wireless trackpad. Verify that the issue is resolved.	K23	MOUSE
	Confirm that the issue with the user's wireless trackpad is: <ul style="list-style-type: none"> Trackpad cursor not responding Does the user's wireless trackpad exhibit this symptom?	No	Go to step 46.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
46.	Verify that the user's wireless trackpad exhibits smooth continuous tracking when used with the known-good computer, and does not skip or behave erratically.	Yes	Replace the user's wireless trackpad. Verify that the issue is resolved.	K12	MOUSE
	Confirm that the issue with the user's wireless trackpad is: <ul style="list-style-type: none"> Trackpad cursor not tracking properly Does the user's wireless trackpad exhibit this symptom?	No	Go to step 47.	\$(nodeText.noSymptomCode)	
47.	Verify that the clicking function of the user's wireless trackpad performs as expected when pressed and released, and that the click is recognized by the known-good computer.	Yes	Replace the user's wireless trackpad. Verify that the issue is resolved.	K13	MOUSE
	Confirm that the issue with the user's wireless trackpad is: <ul style="list-style-type: none"> Trackpad click not recognized Does the user's wireless trackpad exhibit this symptom?	No	Go to step 48.	\$(nodeText.noSymptomCode)	
48.	Verify that the user's wireless trackpad clicking function does not require excessive force when pressed and released.	Yes	Replace the user's wireless trackpad. Verify that the issue is resolved.	K24	MOUSE
	Confirm that the issue with the user's wireless trackpad is: <ul style="list-style-type: none"> Trackpad requires high click force Does the user's wireless trackpad exhibit this symptom?	No	Go to step 49.	\$(nodeText.noSymptomCode)	
49.	Verify that the user's wireless trackpad clicking function is not overly sensitive to clicking when pressed and released.	Yes	Replace the user's wireless trackpad. Verify that the issue is resolved.	K25	MOUSE
	Confirm that the issue with the user's wireless trackpad is: <ul style="list-style-type: none"> Trackpad click oversensitive Does the user's wireless trackpad exhibit this symptom?	No	Go to step 50.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
50.	Verify that the user's wireless trackpad Force Touch function performs as expected and that haptic feedback is felt in response. Note: This feature does not apply to all models.	Yes	Replace the user's wireless trackpad. Verify that the issue is resolved.	K29	MOUSE
	Confirm that the issue with the user's wireless trackpad is: <ul style="list-style-type: none"> Trackpad Force Touch or haptic feedback issue Does the user's wireless trackpad exhibit this symptom?	No	Issue cannot be duplicated.	\${nodeText.noSymptomCode}	

External Apple Wired Keyboard and Mouse

Unlikely causes:

There are no unlikely causes for this issue.

Quick Check

Symptoms	Quick Check
<p>Apple wired USB keyboard or mouse does not function with user's computer or shows one or more of the following symptoms:</p> <ul style="list-style-type: none">• One or more mouse buttons do not click• Mouse scroll ball does not operate smoothly• No mouse response• Keys stick• Keys loose or missing• One or more keys do not respond when pressed• No keyboard response at all• Apple wired mouse causes erratic cursor tracking• Apple wired keyboard or mouse is not recognized• Apple wired keyboard or mouse has physical damage that affects operation• Paint wearing off of one or more keys• Apple wired keyboard or mouse has cosmetic damage that does not affect operation <p>Note: Inform user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	<ol style="list-style-type: none">1. Disconnect all USB devices from the user's computer except for the user's mouse or keyboard. Troubleshoot only one device at a time to help isolate the issue.2. Unplug the keyboard or mouse from the USB port, wait a few seconds, and reconnect it.3. Connect the keyboard or mouse to another USB port on the user's computer.4. Make sure the USB connectors are plugged in completely and correctly.5. Visually inspect the USB connectors and ports for damage or debris.6. Try operating the user's mouse on another surface. Ask the user about the type of surface usually being used with the mouse. Glossy or transparent surfaces, or those with repetitive patterns, may cause mouse-tracking errors or faulty mouse operation. Explain that solid, nonreflective, opaque surfaces work best. The surface should be clean, but not shiny.7. Visually inspect the user's keyboard or mouse for dirt, hair, liquid damage, or other debris. Check to see if the user has pets. Pet hair can lie across the laser and cause intermittent mouse issues. Refer to article HT204172: How to clean your Apple products for information on cleaning the user's keyboard or mouse.8. Connect the user's USB keyboard or mouse to an available USB port on a known-good computer to determine if the issue is related to the USB port on the user's computer, or to the user's USB keyboard or mouse. If the user's keyboard or mouse functions when used with the known-good computer, go to the “USB Port Not Recognized” troubleshooting flow.9. For keyboard issues, refer to HT204540: If your Apple keyboard doesn't work and HT203162: One or more keys on the keyboard do not respond for troubleshooting tips.

Deep Dive

	Check	Result	Action	Code	Commodity
1.	<p>Visually inspect the user's USB mouse or keyboard to verify that the attached USB cable and connector are not damaged or frayed.</p> <p>Check user's keyboard or mouse for physical and liquid damage.</p> <p>On mice, verify that all mouse buttons click and laser tracking LED illuminates.</p> <p>On keyboards, verify that all keys are present and can be depressed normally.</p> <p>Does the user's USB mouse or keyboard, or its attached cable or connector, show signs of damage?</p>	Yes	Go to step 2.	\${nodeText.yesSymptomCode}	
		No	Go to step 12.	\${nodeText.noSymptomCode}	
2.	<p>Isolate damage issue to either user's wired USB keyboard or mouse.</p> <p>Which peripheral is damaged?</p>	USB Keyboard	Go to step 3.	\${nodeText.yesSymptomCode}	
		USB Mouse	Go to step 9.	\${nodeText.noSymptomCode}	
3.	<p>Closely examine user's keyboard to determine exact nature of the issue.</p> <p>Look for any signs of liquid spill, liquid penetration, and liquid damage to keyboard.</p> <p>Is damage to user's keyboard related to liquid spill?</p>	Yes	<p>Replace USB keyboard. Verify issue resolved.</p> <p>Note: Inform user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	K90	KEYBOARD
		No	Go to step 4.	\${nodeText.noSymptomCode}	
4.	<p>Click each key to ensure no keys are sticking in the down or up position.</p> <p>Is damage to user's keyboard related to sticky keys or slow key response?</p>	Yes	<p>Replace USB keyboard. Verify issue resolved.</p> <p>Note: Inform user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	K05	KEYBOARD
		No	Go to step 5.	\${nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
5.	Look for any loose or missing keycaps. Is damage to user's keyboard related to loose or missing keycaps?	Yes	Replace USB keyboard. Verify issue resolved. Note: Inform user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.	K27	KEYBOARD
		No	Go to step 6.	\${nodeText.noSymptomCode}	
6.	Closely inspect the keyboard for any signs of physical damage that may affect operation. Does the user's keyboard exhibit this symptom?	Yes	Replace USB keyboard. Verify issue resolved. Note: Inform user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.	K16	KEYBOARD
		No	Go to Step 7.	\${nodeText.noSymptomCode}	
7.	Closely examine the keyboard for signs of paint wearing off of one or more keys. Does the user's keyboard exhibit this symptom?	Yes	Replace USB keyboard. Verify issue resolved. Note: Inform user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.	K35	KEYBOARD
		No	Go to step 8.	\${nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
8.	<p>Closely inspect the keyboard for any signs of cosmetic damage that does not affect operation.</p> <p>Does the user's keyboard exhibit this symptom?</p>	Yes	<p>Replace USB keyboard. Verify issue resolved.</p> <p>Note: Inform user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	K21	KEYBOARD
		No	Issue cannot be duplicated.	<p> <code> \${nodeText.noSymptomCode} </code> </p>	
9.	<p>Closely examine user's mouse to determine exact nature of the issue.</p> <p>Look for any signs of liquid spill, liquid penetration, and liquid damage to mouse.</p> <p>Is damage to user's mouse related to liquid spill?</p>	Yes	<p>Replace USB mouse. Verify issue resolved.</p> <p>Note: Inform user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	K90	MOUSE
		No	Go to step 10.	<p> <code> \${nodeText.noSymptomCode} </code> </p>	
10.	<p>Closely inspect the mouse for any signs of physical damage that may affect operation.</p> <p>Is there physical damage to user's mouse?</p>	Yes	<p>Replace USB mouse. Verify issue resolved.</p> <p>Note: Inform user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	K16	MOUSE
		No	Go to step 11.	<p> <code> \${nodeText.noSymptomCode} </code> </p>	

	Check	Result	Action	Code	Commodity
11.	Closely inspect the mouse for any signs of cosmetic damage that does not affect operation.	Yes	Replace USB mouse. Verify issue resolved. Note: Inform user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.	K21	MOUSE
	Is there cosmetic damage to user's mouse?	No	Issue cannot be duplicated.	\${nodeText.noSymptomCode}	
12.	Isolate failure issue to either user's wired USB keyboard or mouse.	USB Keyboard	Go to step 17.	\${nodeText.yesSymptomCode}	
	Which peripheral is malfunctioning?	USB Mouse	Go to step 13.	\${nodeText.noSymptomCode}	
13.	Connect user's USB mouse to a free USB port on a known-good computer, and check System Information to determine whether the computer recognizes the mouse.	Yes	Go to step 14.	\${nodeText.yesSymptomCode}	
	Is mouse recognized by a known-good computer?	No	Replace USB mouse. Verify issue resolved.	K15	MOUSE
14.	Move the mouse and verify that the cursor on the known-good computer screen moves smoothly.	Yes	Replace USB mouse. Verify issue resolved.	K26	MOUSE
	Is issue related to mouse function?	No	Go to step 15.	\${nodeText.noSymptomCode}	
15.	Click and roll the mouse's scroll ball to check that it rolls freely in all directions and with no physical resistance.	Yes	Replace USB mouse. Verify issue resolved.	K06	MOUSE
	Is issue related to the scroll ball?	No	Go to step 16.	\${nodeText.noSymptomCode}	
16.	Press the mouse's various buttons to verify that they click properly, without sticking, every time they are pressed.	Yes	Replace USB mouse. Verify issue resolved.	K14	MOUSE
	Is issue related to the mouse button(s)?	No	Issue cannot be duplicated.	\${nodeText.noSymptomCode}	
17.	Connect user's USB keyboard to a free USB port on a known-good computer, and check System Information to determine whether the computer recognizes the keyboard.	Yes	Go to step 18.	\${nodeText.yesSymptomCode}	
	Is keyboard recognized by a known-good computer?	No	Replace USB keyboard. Verify issue resolved.	K15	KEYBOARD

	Check	Result	Action	Code	Commodity
18.	Verify that all keys functions as expected when pressed and released.	Yes	Replace USB keyboard. Verify issue resolved.	K01	KEYBOARD
	Is issue related to specific keys not working?	No	Go to step 19.	\${nodeText.noSymptomCode}	
19.	Verify that the keyboard language is as expected.	Yes	Replace USB keyboard. Verify issue resolved.	K04	KEYBOARD
	Is issue related to keyboard language?	No	Issue cannot be duplicated.	\${nodeText.noSymptomCode}	

Internal Microphone Issues

Unlikely causes:

AC wall adapter (duckhead), battery, bottom case, display assembly, fan, I/O board, power adapter, speakers, TCON flex cable, Touch ID board, trackpad, USB-C charging cable, vent / antenna module.

Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none">• Microphone not working, but audio output is functional• Microphone audio is garbled• Internal microphone input cannot be selected. <p>Note: Inform the user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options. Refer to OP14: Determining and quoting accidental damage for Mac portables.</p>	<p>Important: Disable Auto Boot before performing any troubleshooting steps that require disassembly of the computer, and reenable Auto Boot after the computer has been reassembled and service is completed. Follow steps in TP1484: Auto Boot to enable or disable this function.</p> <ol style="list-style-type: none">1. Go to System Preferences > Sound, and verify the following:<ul style="list-style-type: none">◦ Input tab:<ul style="list-style-type: none">▪ Internal Microphone is available and selected for sound input.▪ “Input volume” slider is not set to zero.◦ Output tab:<ul style="list-style-type: none">▪ Internal Speakers is available and selected for sound output.▪ “Output volume” is not muted or set to zero.2. Go to System Preferences > Sound > Input tab, and verify that the “Input level” indicator moves when speaking into the microphone.3. Check that no cables are inserted into the headphone jack. Use an otoscope to visually inspect jack. Use compressed air to clean and remove any debris.4. Reset the NVRAM using the procedure for this computer in HT204063: Reset NVRAM or PRAM on your Mac.5. Refer to HT201260: Find out which macOS your Mac is using to check that the system build is correct for this computer model.6. Check for and apply the latest software and firmware updates.

Deep Dive

	Check	Result	Action	Code	Commodity
1.	Follow steps in HT208198: About Startup Security Utility to enable starting up from an external storage device on the user’s computer.	Yes	Go to step 2.	\$(nodeText.yesSymptomCode)	
	Start up the computer to a known-good external macOS startup volume. Retest by going to System Preferences > Sound > Input tab, and verifying that the input level indicator moves when speaking into the microphone. Does the issue persist from a known-good OS?	No	Reinstall macOS on the user's computer. Check for and apply the latest software and firmware updates. Verify that the issue is resolved.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
2.	Disconnect any connected headphones or external speakers. Go to System Preferences > Sound > Input tab and verify that Internal Microphone is available and selected for sound input. Does System Preferences list “External Microphone” instead?	Yes	Go to step 3.	\${nodeText.yesSymptomCode}	
		No	Go to step 4.	\${nodeText.noSymptomCode}	
3.	Run AST 2 Audio Test suite to verify that built-in microphone detects expected audio test patterns produced from each speaker. Refer to article TP587: Using Audio Test Does the computer pass AST 2 Audio test suite?	Yes	ESCALATION REQUIRED. Contact ACS for additional support or a multipart repair.	X99	
		No	Go to step 4.	\${nodeText.noSymptomCode}	
4.	The microphone is located along the inner side of the top case and connected to the keyboard with a flex cable. Disconnect the microphone flex cable from the keyboard. Inspect the cable and connectors on the keyboard and microphone flex cable for any damage. Is there any damage to the microphone flex cable or connectors?	Yes	Go to step 5.	\${nodeText.yesSymptomCode}	
		No	Go to step 6.	\${nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
5.	<p>Determine whether the damage is located on the microphone cable, the keyboard (part of top case), or a combination of multiple components.</p> <p>Is the damage limited to the microphone flex cable only?</p>	Yes	<p>Replace the top case assembly.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	K16	KEYBOARD
		No	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	X99	
6.	<p>Reseat the microphone cable connector to the audio board. Retest by going to System Preferences > Sound > Input tab, and verifying that the input level indicator moves when speaking into the microphone.</p> <p>Is microphone functionality restored?</p>	Yes	Go to step 7.	\${nodeText.yesSymptomCode}	
		No	Go to step 8.	\${nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
7.	<p>Run AST 2 Audio Test to verify that built-in microphone detects expected audio test patterns produced from each speaker.</p> <p>Refer to article TP587: Using Audio Test.</p> <p>Does the computer pass AST 2 Audio test suite?</p>	Yes	<p>The issue was resolved by reseating the microphone flex cable.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>	\${nodeText.yesSymptomCode}	
		No	Go to step 8.		
8.	<p>Disconnect the IPD flex cable from the logic board, and keyboard.</p> <p>Check for damage on the IPD flex cable, its connectors, and the keyboard and logic board IPD flex connectors.</p> <p>Inspect connector housings. Look for debris or broken/missing pins that might prevent proper seating.</p> <p>Is there damage to any flex cable or connector?</p>	Yes	Go to step 9.	\${nodeText.yesSymptomCode}	
		No	Go to step 13.		
9.	<p>Determine whether damage is limited to one of the following components, or multiple parts are damaged:</p> <ul style="list-style-type: none"> • IPD flex cable • Keyboard (part of top case) • logic board <p>Is there damage to multiple parts?</p>	Yes	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	X99	
		No	Go to step 10.		

	Check	Result	Action	Code	Commodity
10.	<p>Inspect the IPD flex cable for damage. Pay attention to the body of the cable, looking for pinching, tearing, or crimping, and all ends of the cable.</p> <p>Does the IPD flex cable appear damaged?</p>	Yes	<p>Replace the IPD flex cable.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>	X03	INTERNAL CABLE
		No	Go to step 11.		
11.	<p>Inspect the keyboard IPD flex cable connector for damage.</p> <p>Does the keyboard IPD flex cable connector appear damaged?</p>	Yes	<p>Replace the top case assembly.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	K16	KEYBOARD
		No	Go to step 12.		

	Check	Result	Action	Code	Commodity
12.	<p>Inspect the logic board IPD flex cable connector for damage.</p> <p>Does the logic board IPD flex cable connector appear damaged?</p>	Yes	<p>Replace the logic board and Touch ID board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M24	MLB
		No	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	X99	
13.	<p>Reconnect the IPD flex cable to the keyboard, ensuring a good connection to the keyboard.</p> <p>Reconnect the IPD flex cable to the logic board, ensuring a good connection to both ends.</p> <p>Retest by going to System Preferences > Sound > Input tab, and verifying that the input level indicator moves when speaking into the microphone.</p> <p>Is microphone functionality restored?</p>	Yes	<p>The issue was resolved by reseating the IPD flex cable.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>	<p>\$(nodeText.yesSymptomCode)</p>	
		No	Go to step 14.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
14.	<p>Troubleshooting this issue completely requires a known-good IPD flex cable.</p> <p>Do you have immediate access to a known-good IPD flex cable?</p>	Yes	Go to step 15.	\${nodeText.yesSymptomCode}	
		No	<p>Replace the IPD flex cable.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>	X03	INTERNAL CABLE
15.	<p>Substitute a known-good IPD flex cable.</p> <p>Retest by going to System Preferences > Sound > Input tab, and verifying that the input level indicator moves when speaking into the microphone.</p> <p>Is microphone functionality restored?</p>	Yes	<p>Replace the IPD flex cable.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>	X03	INTERNAL CABLE
		No	Go to step 16.	\${nodeText.noSymptomCode}	
16.	<p>Inspect and reseal audio board flex cable connectors.</p> <p>Inspect cables and connectors for damage. Check audio board and logic board connectors for missing or bent pins that might prevent correct seating.</p> <p>Is damage found on logic board or audio board connectors, or the flex cable?</p>	Yes	Go to step 17.	\${nodeText.yesSymptomCode}	
		No	Go to step 18.	\${nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
17.	<p>Determine whether there is damage to the audio board, its flex cable, the logic board, or to a combination of multiple components.</p> <p>Is the damage limited to the audio board flex cable?</p>	Yes	<p>Replace the audio board flex cable.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>	X03	OTHER ELECTRIC
		No	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	X99	
18.	<p>Retest by going to System Preferences > Sound > Input tab, and verifying that the input level indicator moves when speaking into the microphone.</p> <p>Is microphone functionality restored?</p>	Yes	<p>The issue was resolved by reseating the audio board flex cable.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>	<p> <code> \${nodeText.yesSymptomCode} </code> </p>	
		No	Go to step 19.	<p> <code> \${nodeText.noSymptomCode} </code> </p>	

	Check	Result	Action	Code	Commodity
19.	<p>Troubleshooting this issue completely requires a known-good audio board.</p> <p>Do you have immediate access to a known-good audio board?</p>	Yes	Go to step 20.	\${nodeText.yesSymptomCode}	
		No	<p>Replace the top case assembly.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	K36	KEYBOARD

	Check	Result	Action	Code	Commodity
20.	<p>Substitute a known-good audio board.</p> <p>Retest by going to System Preferences > Sound > Input tab, and verifying that the input level indicator moves when speaking into the microphone.</p> <p>Run AST 2 Audio Test suite to verify that built-in microphone detects expected audio test patterns produced from each speaker.</p> <p>Refer to TP587: Using Audio Test</p> <p>Does the computer pass AST 2 Audio Test suite?</p>	Yes	<p>Replace the audio board.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>	M09	OTHER BOARD
		No	<p>Reinstall the user's I/O board.</p> <p>Replace the top case assembly.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	K36	KEYBOARD
21.	<p>Verify that the Internal Microphone device is available, selected, and functional, and that the "Input level" indicator moves when speaking into the microphone. Then record a sample audio file and play it back to verify that it is free of distortion.</p> <p>Run AST 2 Full System diagnostic suites (EFI & OS), if available, to ensure no other issues remain.</p> <p>Verify that the issue is resolved.</p> <p>Is the issue resolved?</p>	Yes	The issue is resolved. Verify resolution.	<p>{nodeText.yesSymptomCode}</p>	
		No	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	X99	

No Audio from Internal Speakers or Headphone Jack

Unlikely causes:

AC wall adapter (duckhead), battery, bottom case, display assembly, fan, I/O board, IPD flex cable, power adapter, TCON flex cable, top case assembly, Touch ID board, trackpad, USB-C charging cable, vent / antenna module.

Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none">No sound from headphone jackNo sound from left or right speakers <p>Note: Inform the user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options. Refer to OP14: Determining and quoting accidental damage for Mac portables.</p>	<p>Important: Disable Auto Boot before performing any troubleshooting steps that require disassembly of the computer, and reenable Auto Boot after the computer has been reassembled and service is completed. Follow steps in TP1484: Auto Boot to enable or disable this function.</p> <ol style="list-style-type: none">Use controls to increase the sound volume to medium, halfway between minimum and maximum setting.Connect headphones or external speakers to the headphone jack. In System Preferences > Sound > Output, verify whether the Internal Speakers setting switches to Headphones, and whether audio can be played on headphones or external speakers.Disconnect any device connected to the headphone jack. In System Preferences > Sound > Output, check that the sound output device reverts to Internal Speakers and that the Balance slider is set halfway between left and right.Reset the NVRAM using the procedure for this computer in HT204063: Reset NVRAM or PRAM on your Mac.Refer to HT201260: Find out which macOS your Mac is using to check that the system build is correct for this computer model.Check for and apply the latest software and firmware updates.

Deep Dive

	Check	Result	Action	Code	Commodity
1.	Follow steps in HT208198: About Startup Security Utility to enable starting up from an external storage device on the user's computer.	Yes	Go to step 2.	<code>\$(nodeText.yesSymptomCode)</code>	
	Start up the computer to a known-good external macOS startup volume. Retest for speaker or headphone jack audio issue. Does the issue persist with known-good macOS?	No	Reinstall macOS on the user's computer. Check for and apply the latest software and firmware updates. Verify that the issue is resolved.	<code>\$(nodeText.noSymptomCode)</code>	
2.	Use known-good headphones or external speakers to test the output from the external audio port. Verify you can hear audio.	Yes	Go to step 3.	<code>\$(nodeText.yesSymptomCode)</code>	
	Can you hear audio through headphones or external speakers?	No	Go to step 4.	<code>\$(nodeText.noSymptomCode)</code>	

	Check	Result	Action	Code	Commodity
3.	Disconnect headphones/external speakers.	Yes	ESCALATION REQUIRED. Contact ACS for additional support or a multipart repair.	X99	
	Run AST 2 Audio Test suite to verify that left and right speakers produce expected audio test patterns from each speaker.				
	Refer to TP587: Using Audio Test				
	Does the computer pass AST 2 Audio Test suite?	No	Go to step 9.	\$(nodeText.noSymptomCode)	
4.	Follow Service Guide procedures to remove the bottom case and disconnect the battery from the logic board.	Yes	Go to step 5.	\$(nodeText.yesSymptomCode)	
	Inspect and reseal audio board flex cable connectors.	No	Go to step 6.	\$(nodeText.noSymptomCode)	
	Inspect cables and connectors for damage. Check audio board and logic board connectors for missing or bent pins that might prevent correct seating.				
	Is damage found on logic board or audio board connectors, or the flex cable?				
5.	Determine whether there is damage to the audio board, its flex cable, the logic board, or to a combination of multiple components. Is the damage limited to the audio board flex cable?	Yes	Replace the audio board flex cable. Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary. Refer to TP1314: Trackpad Calibration Check for instructions. Verify that the issue is resolved.	X03	OTHER ELECTRIC
		No	ESCALATION REQUIRED. Contact ACS for additional support or a multipart repair.	X99	

	Check	Result	Action	Code	Commodity
6.	<p>Reassemble the computer and connect known-good headphones or external speakers to test the output from the external audio port. Verify you can hear audio.</p> <p>Can you hear audio through the headphones or external speakers?</p>	Yes	<p>The issue was resolved by reseating the audio board flex cable.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>	{nodeText.yesSymptomCode}	
		No	Go to step 7.	{nodeText.noSymptomCode}	
		Yes	Go to step 8.	{nodeText.yesSymptomCode}	
7.	<p>Troubleshooting this issue completely requires a known-good audio board.</p> <p>Do you have immediate access to a known-good audio board?</p>	No	<p>Replace the audio board.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>	M09	OTHER BOARD

	Check	Result	Action	Code	Commodity
8.	<p>Substitute a known-good audio board. Use known-good headphones or external speakers to test the output from the external audio port. Verify you can hear audio.</p> <p>Run AST 2 Audio Test suite to verify that left and right speakers produce expected audio test patterns from each speaker.</p> <p>Refer to TP587: Using Audio Test</p> <p>Does the computer pass AST 2 Audio Test suite?</p>	Yes	<p>Replace the audio board.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>	M09	OTHER BOARD
		No	<p>Reinstall the user's I/O board.</p> <p>Replace the logic board and Touch ID board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M09	MLB
9.	<p>Follow Service Guide procedures to remove the bottom case and disconnect the battery from the logic board.</p> <p>Inspect and reseal left and right speaker connections to logic board.</p> <p>Check speaker wire and connectors for damage. Check logic board connector for missing or bent pins that might prevent correct seating.</p> <p>Did you find damage to speakers or logic board connector?</p>	Yes	Go to step 10.	\${nodeText.yesSymptomCode}	
		No	Go to step 11.	\${nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
10.	<p>Determine whether damage is on the logic board, speakers, or both.</p> <p>Is the damage limited to speakers?</p>	Yes	<p>Speakers are replaced as a matched set. Replace speakers with a matched-pair replacement kit.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>	X03	OTHER ELECTRIC
		No	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	X99	
11.	With speaker connectors reseated to logic board, verify that you can hear audio through internal speakers.	Yes	The issue was resolved by reseating cables. Verify resolution.	`\${nodeText.yesSymptomCode}`	
	<p>In System Preferences > Sound > Output tab, adjust Balance slider to check left and right speaker channel separation.</p> <p>Play music with high and low tones to check bass and tweeter performance of left and right speakers.</p> <p>Do internal speakers present full range of expected audio performance?</p>	No	Go to step 12.	`\${nodeText.noSymptomCode}`	

	Check	Result	Action	Code	Commodity
12.	<p>Troubleshooting this issue completely requires a known-good left/right speaker set.</p> <p>Do you have immediate access to a known-good left/right speaker set.</p>	Yes	Go to step 13.	\$(nodeText.yesSymptomCode}	
		No	<p>Speakers are replaced as a matched set. Replace speakers with a matched-pair replacement kit.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>	X08	OTHER ELECTRIC

	Check	Result	Action	Code	Commodity
13.	<p>Substitute a known-good left/right speaker set and verify you can hear audio through internal speakers.</p> <p>Run AST 2 Audio Test suite to verify that left and right speakers produce expected audio test patterns from each speaker.</p> <p>Refer to TP587: Using Audio Test</p> <p>Does the computer pass AST 2 Audio Test suite?</p>	Yes	<p>Speakers are replaced as a matched set. Replace speakers with a matched-pair replacement kit.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>	X08	OTHER ELECTRIC
		No	<p>Reinstall the user's left/right speaker set.</p> <p>Replace the logic board and Touch ID board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M09	MLB

	Check	Result	Action	Code	Commodity
14.	Connect and disconnect headphones/external speakers. Verify that audio can be played through both external and internal speakers, and that sound is clear and free of distortion. Run AST 2 Full System diagnostic suites (EFI & OS), if available, to ensure no other issues remain. Is the issue resolved?	Yes	The issue is resolved. Verify resolution.	\${nodeText.yesSymptomCode}	
		No	ESCALATION REQUIRED. Contact ACS for additional support or a multipart repair.	X99	

No Audio to External Display Speakers

Unlikely causes:

AC wall adapter (duckhead), battery, bottom case, display assembly, fan, IPD flex cable, power adapter, speakers, TCON flex cable, Touch ID board, trackpad, USB-C charging cable, vent / antenna module.

Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none">• Video but no audio to external display; audio works on internal speakers <p>Note: Inform the user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options. Refer to OP14: Determining and quoting accidental damage for Mac portables.</p>	<p>Important: Disable Auto Boot before performing any troubleshooting steps that require disassembly of the computer, and reenable Auto Boot after the computer has been reassembled and service is completed. Follow steps in TP1484: Auto Boot to enable or disable this function.</p> <ol style="list-style-type: none">1. Gather display type and model information from the user.2. Always use a known-good USB-C Digital AV Multiport Adapter and known-good HDMI display equipped with internal speakers to verify the issue.3. In System Preferences > Sound > Output, select the available DisplayPort, Thunderbolt, HDMI, or USB device for sound output. (The output name varies depending on the display model.)4. On the HDMI display, verify that the correct input has been selected.5. Connect the video adapter to each USB-C connector on the computer and retest each time to isolate a possible faulty USB-C port on the user's computer.6. Test the audio output using more than one application or website.7. Reset the NVRAM using the procedure for this computer in HT204063: Reset NVRAM or PRAM on your Mac.8. Reset the SMC using the procedure for this computer in HT201295: How to reset the System Management Controller (SMC) on your Mac.9. Refer to HT201260: Find out which macOS your Mac is using to check that the system build is correct for this computer model.10. With the user's USB-C Digital AV Multiport Adapter connected to the computer, check for and apply the latest software and firmware updates.11. Refer to the following articles to learn more about Thunderbolt connectivity in this computer:<ul style="list-style-type: none">• HT207443: Adapters for the Thunderbolt 3 (USB-C) or USB-C port on your Mac• HT202488: Apple Thunderbolt cables and adapters

Deep Dive

	Check	Result	Action	Code	Commodity
1.	<p>Connect the known-good display, HDMI cable, and USB-C Digital AV Multiport Adapter to the user's computer.</p> <p>In System Preferences > Sound > Output, check for an available HDMI device for sound output. Select the available device, adjust the volume level on the display, and play the audio file or source.</p> <p>Can the external display audio be selected and play audio on the user's computer?</p>	Yes	Go to step 2.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 3.	`\${nodeText.noSymptomCode}`	
2.	<p>Connect the known-good display and HDMI cable to the user's USB-C Digital AV Multiport Adapter, then to the computer.</p> <p>In System Preferences > Sound > Output, check for an available HDMI device for sound output. Select the available device, adjust the volume level on the display, and play the audio file or source.</p> <p>Can the external display audio be selected and play audio on the user's computer?</p>	Yes	<p>The issue is isolated to the user's display or HDMI cable. Inform the user of findings and refer to HT204388: Connect to HDMI from your Mac for more information.</p>	`\${nodeText.yesSymptomCode}`	
		No	<p>The issue is isolated to the user's adapter.</p> <p>Replace the user's USB-C Digital AV Multiport Adapter or USB-C Digital AV VGA Adapter.</p> <p>If user has third-party adapter, refer to manufacturer for support.</p>	X03	EXTERNAL CABLE

	Check	Result	Action	Code	Commodity
3.	<p>Follow steps in HT208198: About Startup Security Utility to enable starting up from an external storage device on the user's computer.</p> <p>Start up the computer to a known-good external macOS startup volume.</p> <p>Connect the known-good display, HDMI cable, and USB-C Digital AV Multiport Adapter to the user's computer.</p>	Yes	<p>Reinstall macOS on the user's computer.</p> <p>Check for and apply the latest software and firmware updates.</p> <p>Verify that the issue is resolved.</p>	<p> <code> \${nodeText.yesSymptomCode} </code> </p>	
	<p>In System Preferences > Sound > Output, check for an available HDMI device for sound output. Select the available device, adjust the volume level on the display, and play the audio file or source.</p> <p>Can the external display audio be selected and play audio from a known-good OS?</p>	No	Go to step 4.	<p> <code> \${nodeText.noSymptomCode} </code> </p>	
4.	<p>Inspect all USB-C ports and top case openings on the user's computer for any signs of deformation, damage, or debris that may be blocking the connection. Use compressed air to clear any obstructions or debris.</p> <p>Important: Do not use any metal objects to clear debris or obstructions as this can short the connector and cause damage.</p> <p>Is any USB-C port damaged?</p>	Yes	Go to step 5.	<p> <code> \${nodeText.yesSymptomCode} </code> </p>	
		No	Go to step 6.	<p> <code> \${nodeText.noSymptomCode} </code> </p>	

	Check	Result	Action	Code	Commodity
5.	Inspect the opening on the top case for the damaged USB-C port. Determine whether the opening is misshapen or deformed, preventing proper insertion of the USB plug.	Yes	<p>Replace the top case assembly.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	K16	KEYBOARD
	Is the opening for the USB-C port damaged or deformed?	No	<p>Replace the I/O board.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>	M24	OTHER BOARD
6.	<p>Troubleshooting this issue completely requires a known-good I/O board.</p> <p>Do you have immediate access to a known-good I/O board?</p>	Yes	Go to step 7.	`\${nodeText.yesSymptomCode}`	
		No	<p>Replace the I/O board.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>	M09	OTHER BOARD

	Check	Result	Action	Code	Commodity
7.	<p>Substitute a known-good I/O board and reassemble the computer.</p> <p>Connect the known-good display, HDMI cable, and USB-C Digital AV Multiport Adapter to the user's computer. In System Preferences > Sound > Output, check for an available HDMI device for sound output. Select the available device, adjust the output volume level, and play the audio file or source.</p> <p>Can the external display audio be selected and play audio on the user's computer?</p>	Yes	<p>Replace the I/O board.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>	M09	OTHER BOARD
		No	Go to step 8.	\${nodeText.noSymptomCode}	
8.	<p>Reinstall the user's I/O board.</p> <p>Inspect and reseal audio board flex cable connectors.</p> <p>Inspect cables and connectors for damage. Check audio board and logic board connectors for missing or bent pins that might prevent correct seating.</p> <p>Is damage found on logic board or audio board connectors, or the flex cable?</p>	Yes	Go to step 9.	\${nodeText.yesSymptomCode}	
		No	Go to step 10.	\${nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
9.	<p>Determine whether there is damage to the audio board, its flex cable, the logic board, or to a combination of multiple components.</p> <p>Is the damage limited to the audio board flex cable?</p>	Yes	<p>Replace the audio board flex cable.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>	X03	OTHER ELECTRIC
		No	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	X99	
10.	<p>Connect the known-good display, HDMI cable, and USB-C Digital AV Multiport Adapter to the user's computer. In System Preferences > Sound > Output, check for an available HDMI device for sound output. Select the available device, adjust the output volume level, and play the audio file or source.</p> <p>Can the external display audio be selected and play audio on the user's computer?</p>	Yes	<p>The issue was resolved by reseating the audio board flex cable.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>	<p>\$(nodeText.yesSymptomCode)</p>	
		No	Go to step 11.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
11.	<p>Troubleshooting this issue completely requires a known-good audio board.</p> <p>Do you have immediate access to a known-good audio board?</p>	Yes	Go to step 12.	\${nodeText.yesSymptomCode}	
		No	<p>Replace the audio board.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>	M09	OTHER BOARD

	Check	Result	Action	Code	Commodity
12.	<p>Substitute a known-good audio board and reassemble the computer.</p> <p>Connect the known-good display, HDMI cable, and USB-C Digital AV Multiport Adapter to the user's computer. In System Preferences > Sound > Output, check for an available HDMI device for sound output. Select the available device, adjust the output volume level, and play the audio file or source.</p> <p>Can the external display audio be selected and play audio on the user's computer?</p>	Yes	<p>Replace the audio board.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>	M09	OTHER BOARD
		No	<p>Reinstall the user's audio board.</p> <p>Replace the logic board and Touch ID board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M09	MLB
13.	<p>Play a known-good audio file or source and verify that the sound output to display speakers is functional.</p> <p>Run AST 2 Full System diagnostic suites (EFI & OS), if available, to ensure no other issues remain.</p> <p>Is the issue resolved?</p>	Yes	Issue resolved.	\${nodeText.yesSymptomCode}	
		No	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	M99	

Power Button or Touch ID Issues

Unlikely causes:

AC wall adapter (duckhead), audio board, audio board flex cable, battery, bottom case, display assembly, fan, I/O board, IPD flex cable, logic board, power adapter, speakers, TCON flex cable, top case assembly, trackpad, USB-C charging cable, vent / antenna module.

Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none"> • Power button does not click properly or at all • Power button has stiff or spongy feel when pressed • Touch ID is unable to read user's fingerprint • Unable to enroll a user's finger in Touch ID • Unable to unlock computer using Touch ID • Unable to make purchase using Apple Pay and Touch ID <p>Note: Inform user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options. Refer to OP14: Determining and quoting accidental damage for Mac portables.</p>	<p>Important: Disable Auto Boot before performing any troubleshooting steps that require disassembly of the computer, and reenable Auto Boot after the computer has been reassembled and service is completed. Follow steps in TP1484: Auto Boot to enable or disable this function.</p> <ol style="list-style-type: none"> 1. Restart the user's computer. After starting up, the user's computer will first prompt for a passcode, not a fingerprint, even if Touch ID is enabled. This is normal behavior. The only time the computer will authenticate using Touch ID is when waking from sleep, not when starting up. 2. On the computer, have the user go to System Preferences > Touch ID to verify that user has enrolled at least one fingerprint. If no fingerprint is enrolled, Touch ID will be unable to function as expected. 3. Also in System Preferences > Touch ID, verify that the box next to Unlocking your Mac is checked. If it is not, then Touch ID will not unlock the computer. Verify that the box next to iTunes & App Store is checked. If it is not, then Touch ID cannot be used to make purchases in the iTunes Store, App Store, and iBooks Store. Refer to HT207054: Use Touch ID on MacBook Pro for more information about these settings. 4. Refer to HT207037: If the Touch Bar or Touch ID doesn't work on MacBook Pro. 5. Refer to HT201260: How to find the macOS version number on your Mac to check that the system build is correct for this computer model. Apply the latest software and firmware updates. 6. Ensure that the customer's finger and the Touch ID sensor are clean. Check for dirt, debris, oils, lotions, or signs of damage. If necessary, clean the Touch ID sensor and the area surrounding it on the user's computer using a clean microfiber cloth. 7. Check for cases or protective films. Remove them if they are obstructing the Touch ID sensor or the area surrounding it and then retest for Touch ID functionality. 8. Have the user try to enroll another fingerprint on the same computer. 9. Remember that the user's finger needs to move slightly during enrollment. Also, ensure that the user waits for the computer's prompt before lifting a finger. 10. If user's finger does not reliably work on their computer, try enrolling the user's fingerprint on another known-good computer. 11. Enroll your own finger with the user's computer and retest for Touch ID functionality. Be sure to remove any non-user fingerprints from the computer when testing is complete so that you do not inadvertently leave your biometric information on a user's computer. 12. Reset the NVRAM using the procedure for this computer in HT204063: Reset NVRAM or PRAM on your Mac. 13. Reset the SMC using the procedure for this computer in HT201295: How to reset the System Management Controller (SMC) on your Mac. 14. Do not service or replace the computer for issues with a specific finger or fingers. If the user has an issue with certain fingers, explain that in some cases Touch ID may be unable to match those fingers consistently. This is usually caused by the readability of that fingerprint, and the user can either try enrolling the fingerprint at a later time, or use a different finger for Touch ID. <p>If you and the user are unable to enroll any fingerprints on the computer, there is an issue with the Touch ID sensor and the computer should be serviced.</p>

Deep Dive

	Check	Result	Action	Code	Commodity
1.	Identify the type of issue:	A	Go to step 2.	\$(nodeText.yesSymptomCode)	
	A: Touch ID issues such as: <ul style="list-style-type: none"> Unable to read user's fingerprint Unable to enroll a user's fingerprint in Touch ID Unable to unlock computer using Touch ID Unable to make a purchase using Apple Pay and Touch ID B: Power button issues such as: <ul style="list-style-type: none"> Power button does not click properly or at all Power button has a stiff or spongy feel when pressed 	B	Go to step 10.	\$(nodeText.noSymptomCode)	
	Which issue is identified?				
2.	Follow steps in HT208198: About Startup Security Utility to enable starting up from an external storage device on the user's computer.	Yes	Go to step 3.	\$(nodeText.yesSymptomCode)	
	Start up the computer to a known-good external macOS startup volume. Retest for Touch ID issue. Does the issue persist from a known-good OS?	No	Reinstall macOS on the user's computer. Check for and apply the latest software and firmware updates. Verify that the issue is resolved.	\$(nodeText.noSymptomCode)	
3.	Run AST 2 Touch ID diagnostic suite on user's computer.	Yes	Go to step 4.	\$(nodeText.yesSymptomCode)	
	Check diagnostic results to verify the functionality of Touch ID hardware. If AST 2 is not available, repeat Quick Check steps to verify Touch ID functionality. Does the computer pass all tests?	No	Go to step 5.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
4.	Repeat Quick Check steps to verify Touch ID functionality.	Yes	Issue cannot be duplicated.	`\${nodeText.yesSymptomCode}`	
	Touch ID is not responding as expected if: <ul style="list-style-type: none"> There are authentication errors or failures on the user's computer when attempting to use any finger. Multiple people are having problems enrolling any fingerprint. Registration process cannot begin because the computer cannot detect any finger. 	No	Go to step 5.	`\${nodeText.noSymptomCode}`	
	Is Touch ID responding as expected?				
5.	Isolate the Touch ID issue to one of the following symptoms:	Intermittent Response	Go to step 6.	`\${nodeText.yesSymptomCode}`	
	<ul style="list-style-type: none"> Intermittent response to finger No response to finger 	No Response	Go to step 7.	`\${nodeText.noSymptomCode}`	
	Which issue affects Touch ID?				
6.	Check for and apply the latest software and firmware updates to the user's computer.	Yes	Issue resolved by updating macOS.	`\${nodeText.yesSymptomCode}`	
	Run AST 2 Touch ID diagnostic suite on user's computer to retest Touch ID after software update.	No	Go to step 7.	`\${nodeText.noSymptomCode}`	
	Is the issue resolved after software update?				
7.	Follow Service Guide procedures to gain access to the Touch ID board in the top case.	Yes	Go to step 8.	`\${nodeText.yesSymptomCode}`	
	Disconnect the Touch ID board flex cable from the audio board.	No	Go to step 9.	`\${nodeText.noSymptomCode}`	
	Visually inspect the flex cable and connectors for damage.				
	Reconnect and reseal the Touch ID board flex cable to the audio board.				
	Are you able to reseal this cable?				

	Check	Result	Action	Code	Commodity
8.	Reassemble the computer.				
	Run AST 2 Touch ID diagnostic suite on user's computer to retest Touch ID after reseating the Touch ID board flex cable.	Yes	Issue resolved by reseating Touch ID board flex cable.	\${nodeText.yesSymptomCode}	
	Is the issue resolved after reseating cable?	No	Go to step 9.	\${nodeText.noSymptomCode}	
9.	Isolate the Touch ID issue to one of the following symptoms: <ul style="list-style-type: none"> • Touch ID functionality • Apple Pay Which issue affects Touch ID?	Touch ID	Replace the Touch ID board. Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair. Verify that the issue is resolved.	M46	MPU
		Apple Pay	Replace the Touch ID board. Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair. Verify that the issue is resolved.	M47	MPU

	Check	Result	Action	Code	Commodity
10.	<p>Inspect the opening on the top case for the power button.</p> <p>Determine whether the opening is misshapen or deformed, preventing proper button operation.</p> <p>Is the opening for the power button damaged or deformed?</p>	Yes	<p>Replace the top case assembly.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	K16	KEYBOARD
		No	Go to step 11.	\$(nodeText.noSymptomCode)	
11.	<p>Follow Service Guide procedures to remove the bottom case and the logic board to gain access to the Touch ID board in the top case.</p> <p>Follow Service Guide procedures to remove the Touch ID board. Inspect the gap between the top case and the Touch ID board for debris.</p> <p>If any debris is found that may interfere with power button operation, use compressed air to clean out the debris.</p> <p>Follow Service Guide procedures to reassemble the computer and retest for both power button and Touch ID functionality.</p> <p>Is the issue resolved?</p>	Yes	Issue resolved by cleaning Touch ID board area in top case.	\$(nodeText.yesSymptomCode)	
		No	Go to step 12.	\$(nodeText.noSymptomCode)	
12.	<p>Troubleshooting this issue completely requires a known-good Touch ID shim kit.</p> <p>Do you have immediate access to a Touch ID shim kit?</p>	Yes	Go to step 13.	\$(nodeText.yesSymptomCode)	
		No	<p>Order a Touch ID shim kit.</p> <p>Return to this procedure when the kit is available.</p>	X03	PIECE PART

	Check	Result	Action	Code	Commodity
13.	<p>A button that feels too loose or too stiff can be caused by installing an incorrect shim that is too large or small.</p> <p>If the button is not aligned, then follow Service Guide procedures to realign the Touch ID board in the top case.</p> <p>If the button feels too loose or has a spongy feel, then try a larger shim.</p> <p>If the button feels too stiff or does not move, then try a smaller shim.</p> <p>Reinstall the same Touch ID board using the new shim.</p> <p>Reassemble the computer and retest for both power button and Touch ID functionality.</p> <p>Is the issue resolved?</p>	Yes	Issue resolved by adjusting Touch ID board shim size.	\$(nodeText.yesSymptomCode)	
		No	<p>Replace the Touch ID board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M48	MPU
14.	<p>Verify that the Touch ID or power button issue is no longer present</p> <p>Run AST 2 Full System diagnostic suites (EFI & OS), if available, to ensure no other issues remain.</p> <p>Is the issue resolved?</p>	Yes	The issue is resolved.	\$(nodeText.yesSymptomCode)	
		No	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	K99	

USB-C and Thunderbolt Connectivity Issues

Unlikely causes:

Audio board, audio board flex cable, battery, bottom case, display assembly, duckhead, fan, IPD flex cable, power adapter, speakers, TCON flex cable, Touch ID board, trackpad, vent / antenna module.

Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none">Standard USB-C devices not recognized or not powered when connected to computer's USB-C port(s).USB 2 or USB 3 devices not recognized or not powered when connected to computer's USB-C port(s).External DisplayPort or Thunderbolt devices or displays not recognized when connected to computer's USB-C port(s). <p>Note: Inform the user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options. Refer to OP14: Determining and quoting accidental damage for Mac portables.</p>	<p>Important: Disable Auto Boot before performing any troubleshooting steps that require disassembly of the computer, and reenable Auto Boot after the computer has been reassembled and service is completed. Follow steps in TP1484: Auto Boot to enable or disable this function.</p> <p>Note: If the user's issue is that the first connected external display functions, but a second connected external display does not function, try steps A through C before continuing with further troubleshooting:</p> <ol style="list-style-type: none">Ask the user if the issue occurs only when multiple external displays are connected, or if the issue occurs as soon as a single external display is connected.If the issue only appears when multiple external displays are connected, then determine which external display should be connected first, to reproduce the issue during troubleshooting. The issue may only appear when multiple external displays are connected in a specific order.Repeat the troubleshooting procedure steps that follow in this flow with a second known-good USB-C Digital AV Multiport Adapter and two known-good external HDMI displays connected to the user's computer, connected in the order that causes the user's issue to appear. <ol style="list-style-type: none">Verify that any USB hubs connected to the computer have sufficient power for a connected USB device.Check whether the user's USB device requires a specific driver to function properly.If the user is using a USB 3 device, review HT201163: Using USB devices with your Mac.Reset the NVRAM using the procedure for this computer in HT204063: Reset NVRAM or PRAM on your Mac.Reset the SMC using the procedure for this computer in HT201295: How to reset the System Management Controller (SMC) on your Mac. Retest for USB-C connectivity issues.Refer to HT201260: Find out which macOS your Mac is using to check that the system build is correct for this computer model.Using a Wi-Fi network, check for and apply the latest software and firmware updates. Also check for adapter firmware updates by leaving the user's adapter connected to the computer while running software update. If an update is available, update the adapter's firmware before proceeding further, and retest for USB-C connectivity issues.Refer to HT207443: Adapters for the Thunderbolt 3 (USB-C) or USB-C port on your Mac to learn more about Thunderbolt connectivity in this computer.

Deep Dive

	Check	Result	Action	Code	Commodity
1.	<p>Inspect all USB-C ports and top case openings on the user's computer for any signs of deformation, damage, or debris that may be blocking the connection. Use compressed air to clear any obstructions or debris.</p> <p>If possible, also inspect the electromagnetic interference (EMI) springs on each USB-C connector to ensure they are not bent or otherwise damaged.</p> <p>Important: Do not use any metal objects to clear debris or obstructions as this can short the connector and cause damage.</p> <p>Is any USB-C port damaged?</p>	Yes	Go to step 2.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 3.	`\${nodeText.noSymptomCode}`	
2.	<p>Inspect the opening on the top case for the USB-C port. Determine whether the opening is misshapen or deformed, preventing proper insertion of the USB plugs.</p> <p>Is the opening for the USB-C port damaged or deformed?</p>	Yes	<p>Replace the top case assembly.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	K16	KEYBOARD
		No	Go to step 13.	`\${nodeText.noSymptomCode}`	
3.	<p>Connect the user's computer to a known-good Apple USB-C power adapter with a known-good Apple USB-C charging cable that is the correct type for the user's computer.</p> <p>Connect the power adapter to a known-good electrical outlet.</p> <p>Check that the computer recognizes the power adapter.</p> <p>The computer should turn on automatically if it is off when the power adapter is connected.</p> <p>Does the computer recognize the power adapter and turn on?</p>	Yes	Go to step 4.	`\${nodeText.yesSymptomCode}`	
		No	Go to "Does Not Run on Power Adapter" troubleshooting flow.	`\${nodeText.noSymptomCode}`	

	Check	Result	Action	Code	Commodity
4.	Shut down the computer.	Yes	Go to step 5.	`\${nodeText.yesSymptomCode}`	
	<p>Disconnect and flip the orientation of the USB-C charging cable plug, then reconnect it to the same USB-C port on the computer and retest to test both orientations.</p> <p>The computer should turn on automatically.</p> <p>Does the computer recognize the power adapter and turn on?</p>	No	Go to “Does Not Run on Power Adapter” troubleshooting flow.	`\${nodeText.noSymptomCode}`	
5.	Using an Apple USB-C to USB Adapter, connect a known-good high-speed USB (1.1/2.0) device, such as a mouse, keyboard, or USB 2 flash drive to the same USB-C port on the computer.	Yes	Go to step 6.	`\${nodeText.yesSymptomCode}`	
	<p>Verify in System Information > USB that the device is detected.</p> <p>Is the USB 1.1/2.0 device detected?</p>	No	Go to step 13.	`\${nodeText.noSymptomCode}`	
6.	Disconnect and flip the orientation of the USB-C Apple adapter cable plug, then reconnect it to the same USB-C port on the computer and retest, to test both orientations.	Yes	Go to step 7.	`\${nodeText.yesSymptomCode}`	
	<p>Refresh the USB Device Tree in System Information by pressing Command-R, or by choosing File > Refresh Information from the menu bar.</p> <p>Verify in System Information > USB that the device is detected.</p> <p>Is the USB 1.1/2.0 device detected?</p>	No	Go to step 13.	`\${nodeText.noSymptomCode}`	
7.	Using a known-good Apple USB-C to USB Adapter, connect a known-good USB 3 device, such as a USB 3 hard drive or flash drive, to the same USB-C port on the computer.	Yes	Go to step 8.	`\${nodeText.yesSymptomCode}`	
	<p>Verify in System Information > USB that the device is detected.</p> <p>Is the USB 3 device detected?</p>	No	Go to step 13.	`\${nodeText.noSymptomCode}`	

	Check	Result	Action	Code	Commodity
8.	<p>Disconnect and flip the orientation of the USB-C Apple adapter cable plug, then reconnect it to the same USB-C port on the computer and retest, to test both orientations.</p> <p>Refresh the USB Device Tree in System Information by pressing Command-R, or by choosing File > Refresh Information from the menu bar.</p> <p>Verify in System Information > USB that the device is detected.</p> <p>Is the USB 3 device detected?</p>	Yes	Go to step 9.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 13.	`\${nodeText.noSymptomCode}`	
9.	<p>Using the user's Apple USB-C to USB Adapter in place of the known-good adapter, connect a known-good USB 3 device, such as a USB 3 hard drive or flash drive to the same USB-C port on the computer.</p> <p>Refer to HT207443: Adapters for the Thunderbolt 3 (USB-C) or USB-C port on your Mac for more information about Apple USB-C adapters.</p> <p>Refresh the USB Device Tree in System Information by pressing Command-R, or by choosing File > Refresh Information from the menu bar.</p> <p>Verify in System Information > USB that the device is detected.</p> <p>Be sure to test both orientations.</p> <p>Is the USB 3 device detected?</p>	Yes	Go to step 10.	`\${nodeText.yesSymptomCode}`	
		No	<p>Replace the user's Apple USB-C adapter.</p> <p>If the adapter is made by a third party, advise the user to contact the manufacturer for support.</p> <p>Verify that the issue is resolved.</p>	X03	EXTERNAL CABLE
10.	<p>Using a known-good Apple Thunderbolt 3 (USB-C) to Thunderbolt 2 Adapter, connect a known-good external Thunderbolt 2 device such as a display or external disk to the same USB-C port on the computer.</p> <p>Verify in System Information > Thunderbolt that the device is detected.</p> <p>Refer to HT207266: About the Apple Thunderbolt 3 (USB-C) to Thunderbolt 2 Adapter for more information about this adapter.</p> <p>Is the Thunderbolt 2 device detected?</p>	Yes	Go to step 11.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 20.	`\${nodeText.noSymptomCode}`	

	Check	Result	Action	Code	Commodity
11.	<p>Disconnect and flip the orientation of the USB-C Apple adapter cable plug, then reconnect it to the same USB-C port on the computer and retest, to test both orientations.</p> <p>Refresh the USB Device Tree in System Information by pressing Command-R, or by choosing File > Refresh Information from the menu bar.</p> <p>Verify in System Information > Thunderbolt that the device is detected.</p> <p>Is the Thunderbolt 2 device detected?</p>	Yes	Go to step 12.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 20.	`\${nodeText.noSymptomCode}`	
12.	<p>Using the user's Apple Thunderbolt 3 (USB-C) to Thunderbolt 2 Adapter in place of the known-good adapter, connect a known-good external Thunderbolt 2 device such as a display or external disk to the same USB-C port on the computer.</p> <p>Refer to HT207443: Adapters for the Thunderbolt 3 (USB-C) or USB-C port on your Mac for more information about Apple USB-C adapters.</p> <p>Refresh the USB Device Tree in System Information by pressing Command-R, or by choosing File > Refresh Information from the menu bar.</p> <p>Verify in System Information > Thunderbolt that the device is detected.</p> <p>Be sure to test both orientations.</p> <p>Is the Thunderbolt 2 device detected?</p>	Yes	Go to “No Video to External Display” troubleshooting flow.	`\${nodeText.yesSymptomCode}`	
		No	<p>Replace the user's Apple USB-C adapter.</p> <p>If the adapter is made by a third party, advise the user to contact the manufacturer for support.</p> <p>Verify that the issue is resolved.</p>	X03	EXTERNAL CABLE

	Check	Result	Action	Code	Commodity
13.	<p>Inspect all USB-C ports on the computer for any visible damage or debris that may be preventing a connection.</p> <p>Also inspect the EMI springs on each USB-C connector to ensure they are not bent or otherwise damaged.</p> <p>Clear any debris as necessary.</p> <p>Important: Do not use any metal objects to clear debris or obstructions as this can short the connector and cause damage.</p> <p>Is any USB-C receptacle damaged?</p>	Yes	<p>Replace the I/O board.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>	M24	OTHER BOARD
		No	Go to step 14.	#{nodeText.noSymptomCode}	
14.	<p>Troubleshooting this issue completely requires a known-good I/O board.</p> <p>Do you have immediate access to a known-good I/O board?</p>	Yes	Go to step 15.	#{nodeText.yesSymptomCode}	
		No	Go to step 16.	#{nodeText.noSymptomCode}	
15.	<p>Substitute a known-good I/O board and reassemble the computer.</p> <p>Retest for USB-C functionality.</p> <p>Is the issue resolved?</p>	Yes	Go to step 16.	#{nodeText.yesSymptomCode}	
		No	Go to step 18.	#{nodeText.noSymptomCode}	
16.	<p>Determine if the following symptom was observed on the user's computer:</p> <p>USB device not detected.</p> <p>Does this symptom accurately describe the user's issue?</p>	Yes	<p>Replace the I/O board.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>	M37	OTHER BOARD
		No	Go to step 17.	#{nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
17.	Determine if the following symptom was observed on the user's computer: USB port has insufficient power. Does this symptom accurately describe the user's issue?	Yes	Replace the I/O board. Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary. Refer to TP1314: Trackpad Calibration Check for instructions. Verify that the issue is resolved.	M38	OTHER BOARD
		No	Replace the I/O board. Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary. Refer to TP1314: Trackpad Calibration Check for instructions. Verify that the issue is resolved.	M15	OTHER BOARD

	Check	Result	Action	Code	Commodity
18.	Determine if the following symptom was observed on the user's computer: USB device not detected. Does this symptom accurately describe the user's issue?	Yes	Reinstall the user's I/O board. Replace the logic board and Touch ID board. Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair. Verify that the issue is resolved.	M37	MLB
		No	Go to step 19.	\${nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
19.	USB port has insufficient power. Does this symptom accurately describe the user's issue?	Yes	Reinstall the user's I/O board. Replace the logic board and Touch ID board. Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair. Verify that the issue is resolved.	M38	MLB
		No	Reinstall the user's I/O board. Replace the logic board and Touch ID board. Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair. Verify that the issue is resolved.	M15	MLB

	Check	Result	Action	Code	Commodity
20.	<p>Inspect all USB-C ports on the computer for any visible damage or debris that may be preventing a connection.</p> <p>Also inspect the EMI springs on each USB-C connector to ensure they are not bent or otherwise damaged.</p> <p>Clear any debris as necessary.</p> <p>Important: Do not use any metal objects to clear debris or obstructions as this can short the connector and cause damage.</p> <p>Is any USB-C receptacle damaged?</p>	Yes	<p>Replace the I/O board.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>	M24	OTHER BOARD
		No	Go to step 21.	\$(nodeText.noSymptomCode)	
21.	<p>Troubleshooting this issue completely requires a known-good I/O board.</p> <p>Do you have immediate access to a known-good I/O board?</p>	Yes	Go to step 22.	\$(nodeText.yesSymptomCode)	
		No	Go to step 23.	\$(nodeText.noSymptomCode)	
22.	<p>Substitute a known-good I/O board and reassemble the computer.</p> <p>Retest for USB-C functionality.</p> <p>Is the issue resolved?</p>	Yes	Go to step 23.	\$(nodeText.yesSymptomCode)	
		No	Go to step 25.	\$(nodeText.noSymptomCode)	
23.	<p>Determine if the following symptom was observed on the user's computer:</p> <p>USB device not detected.</p> <p>Does this symptom accurately describe the user's issue?</p>	Yes	<p>Replace the I/O board.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>	M37	OTHER BOARD
		No	Go to step 24.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
24.	Determine if the following symptom was observed on the user's computer: USB port has insufficient power. Does this symptom accurately describe the user's issue?	Yes	Replace the I/O board. Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary. Refer to TP1314: Trackpad Calibration Check for instructions. Verify that the issue is resolved.	M38	OTHER BOARD
		No	Replace the I/O board. Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary. Refer to TP1314: Trackpad Calibration Check for instructions. Verify that the issue is resolved.	M15	OTHER BOARD

	Check	Result	Action	Code	Commodity
25.	<p>Determine if the following symptom was observed on the user's computer:</p> <p>Thunderbolt display functionality issue.</p> <p>Does this symptom accurately describe the user's issue?</p>	Yes	<p>Reinstall the user's I/O board.</p> <p>Replace the logic board and Touch ID board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M32	MLB
		No	Go to step 26.	\${nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
26.	<p>Determine if the following symptom was observed on the user's computer:</p> <p>Thunderbolt not providing enough power.</p> <p>Does this symptom accurately describe the user's issue?</p>	Yes	<p>Reinstall the user's I/O board.</p> <p>Replace the logic board and Touch ID board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M34	MLB
		No	<p>Reinstall the user's I/O board.</p> <p>Replace the logic board and Touch ID board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M33	MLB

	Check	Result	Action	Code	Commodity
27.	Confirm that known-good USB high-speed and SuperSpeed devices and Thunderbolt 2 devices are functional and recognized when connected to all USB-C ports on the computer, in both orientations.	Yes	The issue is resolved. Verify resolution.	\${nodeText.yesSymptomCode}	
	<p>Run AST 2 Full System diagnostic suites (EFI & OS), if available, to ensure no other issues remain.</p> <p>Is the issue resolved?</p>	No	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	X99	

Flash Storage Not Recognized, Not Mounting, or Read/Write Issues

Unlikely causes:

AC wall adapter (duckhead), audio board, audio board flex cable, battery, bottom case, display assembly, fan, I/O board, IPD flex cable, power adapter, speakers, TCON flex cable, top case assembly, Touch ID board, trackpad, USB-C charging cable, vent / antenna module.

Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none">Starts up to a black screen with Apple logo.Displays a flashing folder with question mark or prohibitory symbol.Cannot save documents.Displays read/write error messages.Not responding when accessing or saving data. <p>Note: Inform the user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options. Refer to OP14: Determining and quoting accidental damage for Mac portables.</p>	<p>Important: Disable Auto Boot before performing any troubleshooting steps that require disassembly of the computer, and reenable Auto Boot after the computer has been reassembled and service is completed. Follow steps in TP1484: Auto Boot to enable or disable this function.</p> <p>Important: Always ask if the user's data has been backed up before beginning the repair.</p> <ol style="list-style-type: none">Disconnect all peripherals and attempt to start up the computer.To restore the default startup disk, reset the NVRAM using the procedure for this computer in HT204063: Reset NVRAM or PRAM on your Mac.Reset the SMC using the procedure listed for this computer in HT201295: How to reset the System Management Controller (SMC) on your Mac.

Deep Dive

	Check	Result	Action	Code	Commodity
1.	Use one of the following two methods to start up the computer to a known-good macOS.	Yes	Go to step 2.	\$(nodeText.yesSymptomCode)	
	<p>Start up the computer to macOS Recovery. See HT201314: About macOS Recovery.</p> <p>Follow steps in HT208198: About Startup Security Utility to enable starting up from an external storage device on the user's computer. Then start up the computer to a known-good external macOS startup volume.</p> <p>During startup, allow up to four minutes for a defective flash storage to time out, after which the computer will start up from a known-good external device.</p> <p>Does the computer start up from a known-good volume?</p>	No	Go to the "Will Not Start Up" troubleshooting flow.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
2.	<p>Run AST 2 Storage diagnostic test suite on the user's computer and examine the results of the test.</p> <p>Do all internal drive tests pass?</p>	Yes	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	M99	
		No	Go to step 3.	\$(nodeText.noSymptomCode)	
3.	<p>Examine AST 2 Storage diagnostic test suite results for presence of an internal drive.</p> <p>Does the computer pass or fail drive presence test?</p>	Pass	Go to step 4.	\$(nodeText.yesSymptomCode)	
		Fail	<p>Replace the logic board and Touch ID board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M43	MLB
4.	<p>Examine diagnostic results for SMART status.</p> <p>Does the computer pass or fail SMART test?</p>	Pass	Go to step 5.	\$(nodeText.yesSymptomCode)	
		Fail	<p>Replace the logic board and Touch ID board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M43	MLB

	Check	Result	Action	Code	Commodity
5.	Examine diagnostic results for Short Random Multi-Block Read Test. Does the computer pass or fail Short Random Multi-Block Read Test?	Pass	Go to step 6.	\$(nodeText.yesSymptomCode)	
		Fail	<p>Replace the logic board and Touch ID board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M45	MLB
6.	Examine diagnostic results for File System Check. Does the computer pass or fail File System Check?	Pass	Go to step 7.	\$(nodeText.yesSymptomCode)	
		Fail	Go to step 9.	\$(nodeText.noSymptomCode)	
7.	Examine diagnostic results for Bootable Volume Presence Check. Does the computer pass or fail Bootable Volume Check?	Pass	Go to step 8.	\$(nodeText.yesSymptomCode)	
		Fail	Go to step 9.	\$(nodeText.noSymptomCode)	
8.	Examine diagnostic results for Last OS Reinstall Check. Does the computer pass or fail Last OS Reinstall Check?	Pass	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	M99	
		Fail	Go to step 9.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
9.	Use one of the following two methods to start up the computer to a known-good macOS.	Yes	Go to step 10.	\$(nodeText.yesSymptomCode)	
	<p>Start up the computer to macOS Recovery. See HT201314: About macOS Recovery</p> <p>Follow steps in HT208198: About Startup Security Utility to enable starting up from an external storage device on the user's computer. Then start up the computer to a known-good external macOS startup volume.</p> <p>Use Disk Utility to repair the user's internal flash storage volume.</p> <p>Attempt to start up the user's computer from its internal flash storage.</p> <p>Does the computer start up successfully from its internal flash storage?</p>	No	Go to step 11.	\$(nodeText.noSymptomCode)	
10.	<p>Run AST 2 Storage diagnostic test suite on the user's computer again and examine the results of the test.</p> <p>Does the computer pass all internal drive tests?</p>	Yes	The issue was resolved by repairing the flash storage volume. Verify resolution.	\$(nodeText.yesSymptomCode)	
		No	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	M99	

	Check	Result	Action	Code	Commodity
11.	Start up the computer to macOS Recovery or a known-good external macOS startup volume. Run Disk Utility and select the user's flash storage drive.	Yes	Go to step 10.	\$(nodeText.yesSymptomCode)	
	<p>Erase the flash storage drive using Mac OS Extended (Case-sensitive, Journaled) format and GUID Partition Map scheme.</p> <p>Erase the flash storage drive again using Mac OS Extended (Journaled) format and GUID Partition Map scheme.</p> <p>Formatting the drive twice with different partition map schemes will force a rewrite of the partitions table.</p> <p>Refer to HT204743: Partition a problematic drive two times before recommending service or replacement for more information.</p> <p>Reinstall macOS on the user's computer.</p> <p>Check for and apply the latest software and firmware updates.</p> <p>Does the computer start up successfully from its internal flash storage?</p>	No	<p>Replace the logic board and Touch ID board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M44	MLB
12.	Confirm that computer can successfully start up from internal flash storage.	Yes	The issue is resolved. Verify resolution.	\$(nodeText.yesSymptomCode)	
	<p>Run AST 2 Full System diagnostic suites (EFI & OS), if available, to ensure no other issues remain.</p> <p>Is issue resolved?</p>	No	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	M99	

Burning Smell or Odor

Unlikely causes:

There are no unlikely causes for this issue.

Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none">Computer or power adapter emits a burning, smoky, or other unusual odor. <p>Note: Inform the user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options. Refer to OP14: Determining and quoting accidental damage for Mac portables.</p>	<p>Important: Disable Auto Boot before performing any troubleshooting steps that require disassembly of the computer, and reenable Auto Boot after the computer has been reassembled and service is completed. Follow steps in TP1484: Auto Boot to enable or disable this function.</p> <ol style="list-style-type: none">Disconnect the power adapter and any peripherals from the computer.Inspect the enclosure and components for obvious signs of burning or smoky residue. Check the rear vents, keyboard, slots, and ports, as well as the power adapter, USB-C connector, and charging cable.Clean the enclosure to eliminate any causes due to external contamination.Verify that the vents allow unobstructed airflow into and out of the computer.

Deep Dive

	Check	Result	Action	Code	Commodity
1.	Determine whether this is a safety issue. Do not perform procedures that can be a safety risk to you or the user. Have you identified a safety issue?	Yes	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for safety-related issues. Refer to article OP44: Handling Potential Product Safety Issues.</p> <p>Retail: Document the issue and escalate following the steps in RS60: Product Safety Escalations.</p>	X99	
		No	Go to step 2.	`\${nodeText.noSymptomCode}`	
2.	An odor can be related to external contamination. Inspect the computer exterior for contamination or lack of cleanliness. Can you determine that the odor is caused by external contamination?	Yes	Go to step 3.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 4.	`\${nodeText.noSymptomCode}`	

	Check	Result	Action	Code	Commodity
3.	<p>Thoroughly clean enclosure and all external surfaces. Refer to HT204172: How to clean your Apple products. Explain the cause to the user.</p> <p>Does user agree that the odor is due to external contamination?</p>	Yes	The issue is resolved. Verify resolution.	`\${nodeText.yesSymptomCode}`	
		No	ESCALATION REQUIRED. Contact ACS for additional support or a multipart repair.	X99	
4.	<p>Odors can be related to product newness. Refer to HT202324: Odors may be present short-term.</p> <p>Can you determine that the odor is due to the product being new?</p>	Yes	Go to step 5.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 6.	`\${nodeText.noSymptomCode}`	
5.	<p>Explain to the user that new computers can sometimes emit an odor, similar to odors generated from new carpeting or a new car. In most cases, the odor dissipates after a brief period.</p> <p>Does the user agree that the odor is related to the computer being new?</p>	Yes	The issue is resolved. Verify resolution.	`\${nodeText.yesSymptomCode}`	
		No	ESCALATION REQUIRED. Contact ACS for additional support or a multipart repair.	X99	
6.	<p>Closely inspect internal components and the enclosure for indications of physical damage or contamination.</p> <p>Can you identify signs of internal damage or contamination?</p>	Yes	Go to the “Mechanical, Physical, or Cosmetic Damage” troubleshooting flow.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 7.	`\${nodeText.noSymptomCode}`	
7.	<p>Refer to TP1150: Visual/Mechanical Inspection (VMI) Guide for Mac Liquid Damage for guidance regarding possible liquid damage to the user’s computer.</p> <p>Does the computer exhibit this type of damage?</p>	Yes	Go to the “Mechanical, Physical, or Cosmetic Damage” troubleshooting flow.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 8.	`\${nodeText.noSymptomCode}`	

	Check	Result	Action	Code	Commodity
8.	<p>Closely inspect internal hardware and the enclosure for other possible causes of odor, such as bulging or vented chip capacitors, or visible residue or burn marks on the enclosure, logic board, or other components.</p> <p>Have you identified a component failure as the source of the odor?</p>	Yes	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	X99	
		No	The issue cannot be duplicated.	\${nodeText.noSymptomCode}	
9.	<p>Run the computer for several hours and monitor for the issue/odor. Run the full system diagnostics available in AST 2. If no functional failure is detected, use correct positioning to explain to the user that the odor is related to external contamination or the newness of the computer.</p> <p>Is the issue resolved?</p>	Yes	The issue is resolved.	\${nodeText.yesSymptomCode}	
		No	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	X99	

Computer Runs Hot

Unlikely causes:

AC wall adapter (duckhead), audio board, audio board flex cable, bottom case, display assembly, I/O board, power adapter, speakers, TCON flex cable, Touch ID board, USB-C charging cable, vent / antenna module.

Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none">• Computer feels unusually warm.• Fan is not operating.• Fan is not functioning at full capacity.• Fan runs constantly at high speeds. <p>Note: Inform the user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options. Refer to article OP14: Determining and quoting accidental damage for Mac portables.</p>	<p>Important: Disable Auto Boot before performing any troubleshooting steps that require disassembly of the computer, and reenable Auto Boot after the computer has been reassembled and service is completed. Follow steps in TP1484: Auto Boot to enable or disable this function.</p> <ol style="list-style-type: none">1. Check for and apply the latest software and firmware updates.2. Verify the temperature issue with the computer resting on a hard, flat surface. Note: Use this opportunity to educate the user about inappropriate work surfaces that may cause the computer to overheat. Refer to article HT201640: Keep your Mac notebook within acceptable operating temperatures.3. Compare the computer's operating temperature to a known-good, similarly configured computer.4. Check for runaway applications using the information in HT203184: See how apps affect Mac performance, battery runtime, temperature, and fan activity. Follow the instructions to halt any processes that are using excessive system resources.5. Processor-intensive or graphics-intensive applications and system processes may cause the bottom case to feel warm. Use Activity Monitor to identify these types of applications and explain the issue to the user.6. Reset the SMC using the procedure listed for this computer in HT201295: How to reset the System Management Controller (SMC) on your Mac.

Deep Dive

	Check	Result	Action	Code	Commodity
1.	While connected to the user's power adapter and charging cable, run AST 2 Mac Resource Inspector diagnostic suite (MRI) to gather diagnostic information about the computer.	Yes	Go to step 2.	<code>\$(nodeText.yesSymptomCode)</code>	
	MRI will report a failure if any sensors are not detected or are exceeding expected thermal values.	No	Go to step 3.	<code>\$(nodeText.noSymptomCode)</code>	
	Does the computer pass all MRI tests?				

	Check	Result	Action	Code	Commodity
2.	Run AST 2 Cooling System Diagnostic (CSD) diagnostics suite. CSD works like a stress test on the computer, gathering information about the thermal performance while various components are under heavy use. Does the computer pass all CSD tests?	Yes	The computer passed all thermal checks and is operating within specifications. Verify correct operation and refer the customer to HT201640: Keep your Mac notebook within acceptable operating temperatures.	\$(nodeText.yesSymptomCode)	
		No	Go to step 3.	\$(nodeText.noSymptomCode)	
3.	Check diagnostic results for thermal sensor errors, which include sensor codes: <ul style="list-style-type: none"> • TS0P • TS1P Did diagnostics report any trackpad thermal sensor (TS0P, TS1P) errors?	Yes	Go to step 4.	\$(nodeText.yesSymptomCode)	
		No	Go to step 15.	\$(nodeText.noSymptomCode)	
4.	Disconnect the IPD flex cable from the logic board, keyboard, and trackpad. Check for damage on the IPD flex cable, its connectors, and the trackpad, keyboard, and logic board IPD flex connectors. Inspect connector housings. Look for debris or broken/missing pins that might prevent proper seating. Is there damage to any flex cable or connector?	Yes	Go to step 5.	\$(nodeText.yesSymptomCode)	
		No	Go to step 10.	\$(nodeText.noSymptomCode)	
5.	Determine whether damage is limited to one of the following components, or multiple parts are damaged: <ul style="list-style-type: none"> • IPD flex cable • Trackpad • Keyboard (part of top case) • logic board Is there damage to multiple parts?	Yes	ESCALATION REQUIRED. Contact ACS for additional support or a multipart repair.	X99	
		No	Go to step 6.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
6.	<p>Inspect the IPD flex cable for damage. Pay attention to the body of the cable, looking for pinching, tearing, or crimping, and all ends of the cable.</p> <p>Does the IPD flex cable appear damaged?</p>	Yes	<p>Replace the IPD flex cable.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>	X03	INTERNAL CABLE
		No	Go to step 7.	\${nodeText.noSymptomCode}	
7.	<p>Inspect the trackpad IPD flex cable connector for damage.</p> <p>Does the trackpad IPD flex cable connector appear damaged?</p>	Yes	<p>Replace the trackpad.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>	K16	MOUSE
		No	Go to step 8.	\${nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
8.	<p>Inspect the keyboard IPD flex cable connector for damage.</p> <p>Does the keyboard IPD flex cable connector appear damaged?</p>	Yes	<p>Replace the top case assembly.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	K16	KEYBOARD
		No	Go to step 9.	\${nodeText.noSymptomCode}	
9.	<p>Inspect the logic board IPD flex cable connector for damage.</p> <p>Does the logic board IPD flex cable connector appear damaged?</p>	Yes	<p>Replace the logic board and Touch ID board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M24	MLB
		No	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	X99	

	Check	Result	Action	Code	Commodity
10.	<p>Reconnect the IPD flex cable to the keyboard, ensuring a good connection to the keyboard.</p> <p>Reconnect the IPD flex cable to the logic board and trackpad, ensuring a good connection to both ends.</p> <p>Reassemble the computer and run diagnostics again.</p> <p>Do diagnostics still report the sensor failure?</p>	Yes	Go to step 11.	\${nodeText.yesSymptomCode}	
		No	<p>Issue resolved by reseating IPD flex cable.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>	\${nodeText.noSymptomCode}	
11.	<p>Troubleshooting this issue completely requires a known-good IPD flex cable.</p> <p>Do you have immediate access to a known-good IPD flex cable?</p>	Yes	Go to step 12.	\${nodeText.yesSymptomCode}	
		No	<p>Replace the IPD flex cable.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>	X03	INTERNAL CABLE
12.	<p>Substitute a known-good IPD flex cable.</p> <p>Run AST 2 Trackpad Diagnostic suite.</p> <p>Reassemble the computer and run diagnostics again.</p> <p>Do diagnostics still report the sensor failure?</p>	Yes	Go to step 13.	\${nodeText.yesSymptomCode}	
		No	<p>Replace the IPD flex cable.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>	X03	INTERNAL CABLE

	Check	Result	Action	Code	Commodity
13.	<p>Troubleshooting this issue completely requires a known-good trackpad.</p> <p>Do you have immediate access to a known-good trackpad?</p>	Yes	Go to step 14.	\${nodeText.yesSymptomCode}	
		No	<p>Replace the trackpad.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>	K85	MOUSE

	Check	Result	Action	Code	Commodity
14.	<p>Substitute a known-good trackpad.</p> <p>Run AST 2 Trackpad Diagnostic suite.</p> <p>Reassemble the computer and run diagnostics again.</p>	Yes	<p>Reinstall the user's trackpad.</p> <p>Replace the logic board and Touch ID board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M18	MLB
	<p>Do diagnostics still report the sensor failure?</p>	No	<p>Replace the trackpad.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>	K85	MOUSE

	Check	Result	Action	Code	Commodity
15.	<p>Check diagnostic results for battery thermal sensor errors, which include sensor codes:</p> <ul style="list-style-type: none"> • TB0T • TB1T • TB2T <p>Did diagnostics report any battery thermal sensor (TB0T, TB1T, TB2T) errors?</p>	Yes	<p>Replace the battery.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>	P17	BATTERY
		No	Go to step 16.	\$_{nodeText.noSymptomCode}	
16.	<p>A disconnected or nonfunctional fan will prevent proper cooling and cause thermal sensors to exceed expected values.</p> <p>Check diagnostic results for fan motor failures.</p> <p>Did diagnostics report any fan motor test failure?</p>	Yes	Go to step 17.	\$_{nodeText.yesSymptomCode}	
		No	Go to step 23.	\$_{nodeText.noSymptomCode}	
17.	<p>Disconnect the fan flex cable connector and inspect logic board and cable connector pins for damage. Check for a damaged connector or bent pins that prevent correct seating.</p> <p>Inspect the fan flex cable for cable damage.</p> <p>Did you find damage to the fan flex cable or any connector?</p>	Yes	Go to step 18.	\$_{nodeText.yesSymptomCode}	
		No	Go to step 19.	\$_{nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
18.	<p>Determine whether the damage is located on the fan flex cable, the logic board, or both.</p> <p>Is the damage limited to the fan flex cable?</p>	Yes	<p>Replace the fan.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>	X22	OTHER ELECTRIC
		No	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	P99	
19.	<p>Carefully reseal the fan flex cable into its connector.</p> <p>Reassemble the computer and run diagnostics again.</p> <p>Do diagnostics still report a fan failure?</p>	Yes	Go to step 20.	\${nodeText.yesSymptomCode}	
		No	Issue resolved by reseating fan flex cable. Verify resolution.	\${nodeText.noSymptomCode}	
20.	<p>Remove the fan to reveal inner side of heat sink. Use an ESD-safe vacuum to remove dust and debris from heat sink and fan.</p> <p>Reassemble the computer and run diagnostics again.</p> <p>Do diagnostics still report a fan failure?</p>	Yes	Go to step 21.	\${nodeText.yesSymptomCode}	
		No	Issue resolved by cleaning fan and heat sink. Verify resolution.	\${nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
21.	<p>Troubleshooting this issue completely requires a known-good fan.</p> <p>Do you have immediate access to a known-good fan?</p>	Yes	Go to step 22.	\${nodeText.yesSymptomCode}	
		No	<p>Replace the fan.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>	X22	OTHER ELECTRIC
22.	<p>Substitute a known-good fan.</p> <p>Reassemble the computer and run diagnostics again.</p> <p>Do diagnostics still report a fan failure?</p>	Yes	<p>Reinstall the user's fan.</p> <p>Replace the logic board and Touch ID board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M18	MLB
		No	<p>Replace the fan.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>	X22	OTHER ELECTRIC

	Check	Result	Action	Code	Commodity
23.	<p>Check diagnostic results for failures related to any other logic board thermal sensor errors, which include sensor codes:</p> <ul style="list-style-type: none"> • TC0P • TCaP • TCHP • TH0a • TM0P • TSMP • TS0P • TS1P • TUDD • TW0P <p>Did diagnostics report any logic board thermal sensor errors?</p>	Yes	<p>Replace the logic board and Touch ID board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M18	MLB
		No	<p>The computer passed all thermal checks, and is operating within specifications. Verify correct operation and refer the customer to HT201640: Keep your Mac notebook within acceptable operating temperatures.</p> <p>If the diagnostic is reporting other errors, select a different symptom based on the diagnostic results.</p>	<p> <code> \${nodeText.noSymptomCode} </code> </p>	
24.	<p>Use Cooling System Diagnostic to verify that the computer is running within thermal specifications.</p> <p>Run AST 2 Full System diagnostic suites (EFI & OS), if available, to ensure no other issues remain.</p> <p>Is the issue resolved?</p>	Yes	The issue is resolved.	<p> <code> \${nodeText.yesSymptomCode} </code> </p>	
		No	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	X99	

Mechanical, Physical, or Cosmetic Damage

Unlikely causes:

There are no unlikely causes for this issue.

Quick Check

Symptoms	Quick Check
<p>The computer shows signs of physical and/or cosmetic damage such as:</p> <p>Enclosure:</p> <ul style="list-style-type: none">Loose or broken hingesStripped, loose, or missing screwLiquid spill <p>Display Assembly:</p> <ul style="list-style-type: none">Cracked or broken display frame and/or assembly housingScratchesDentsLiquid spill <p>Keyboard and Top Case:</p> <ul style="list-style-type: none">Worn paint on one or more keys on the built-in keyboardScratchesDentsLiquid spill <p>AC Power Adapter:</p> <ul style="list-style-type: none">Mechanical damage to adapter connector, cable, or housingScratchesDentsLiquid spill <p>Note: Inform the user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options. Refer to article OP14: Determining and quoting accidental damage for Mac portables.</p>	<p>Important: Disable Auto Boot before performing any troubleshooting steps that require disassembly of the computer, and reenable Auto Boot after the computer has been reassembled and service is completed. Follow steps in TP1484: Auto Boot to enable or disable this function.</p> <ol style="list-style-type: none">Inspect the computer and discuss the nature of the issue with the user. Determine whether the user wants to proceed with the repair (despite possible accidental damage) or pursue other service options. Click “No” to proceed with further troubleshooting.Refer to TP1151: Visual/Mechanical Inspection (VMI) Guide for Mac Computers for guidance regarding possible damage to the user’s computer.Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.

Deep Dive

	Check	Result	Action	Code	Commodity
1.	Determine the cause of damage or defects: user, technician, environment, accidental damage, or abuse.	Yes	ESCALATION REQUIRED. Contact ACS for assistance with Apple-related accidental damage.	X99	
	Is an Apple technician responsible for the damage or defect on the computer?	No	Go to step 2.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
2.	<p>Closely examine the user's computer for signs of enclosure damage such as:</p> <ul style="list-style-type: none"> • Hinges are loose or broken. • Screw is stripped, loose, or missing. <p>Does the computer exhibit this type of damage?</p>	Yes	<p>Proceed with repair creation to see available options. Inform the user that computer failures due to accidental damage are not covered by Apple's one-year limited warranty or the AppleCare Protection Plan (APP).</p> <p>Refer to www.apple.com/legal/warranty for details.</p>	X12	ENCLOSURE
		No	Go to step 3.	\$(nodeText.noSymptomCode)	
3.	<p>Closely examine the user's computer for signs of enclosure damage such as:</p> <ul style="list-style-type: none"> • Scratches • Dents • Cracks <p>Does the computer exhibit this type of damage?</p>	Yes	<p>Proceed with repair creation to see available options. Inform the user that computer failures due to accidental damage are not covered by Apple's one-year limited warranty or the AppleCare Protection Plan (APP).</p> <p>Refer to www.apple.com/legal/warranty for details.</p>	X13	ENCLOSURE
		No	Go to step 4.	\$(nodeText.noSymptomCode)	
4.	<p>Closely examine the user's computer enclosure for signs of liquid spill damage.</p> <p>Look for any signs of liquid spill, liquid penetration, or liquid damage to the computer's enclosure.</p> <p>Does the computer exhibit this type of damage?</p>	Yes	<p>Proceed with repair creation to see available options. Inform the user that computer failures due to accidental damage are not covered by Apple's one-year limited warranty or the AppleCare Protection Plan (APP).</p> <p>Refer to www.apple.com/legal/warranty for details.</p>	X90	ENCLOSURE
		No	Go to step 5.	\$(nodeText.noSymptomCode)	
5.	<p>Closely examine the user's computer for signs of display assembly damage, such as a cracked or broken display frame or assembly housing.</p> <p>Note: For cracked display glass issues, return to the list of symptoms and select the "Cracked Display" troubleshooting flow.</p> <p>Does the computer exhibit this type of damage?</p>	Yes	<p>Proceed with repair creation to see available options. Inform the user that computer failures due to accidental damage are not covered by Apple's one-year limited warranty or the AppleCare Protection Plan (APP).</p> <p>Refer to www.apple.com/legal/warranty for details.</p>	L18	LCD
		No	Go to step 6.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
6.	<p>Closely examine the user's computer display assembly for signs of cosmetic damage, such as:</p> <ul style="list-style-type: none"> Scratches Dents <p>Does the computer exhibit this type of damage?</p>	Yes	<p>Proceed with repair creation to see available options. Inform the user that computer failures due to accidental damage are not covered by Apple's one-year limited warranty or the AppleCare Protection Plan (APP).</p> <p>Refer to www.apple.com/legal/warranty for details.</p>	L19	LCD
		No	Go to step 7.	\$(nodeText.noSymptomCode)	
7.	<p>Closely examine the user's computer display assembly for signs of liquid spill damage.</p> <p>Look for any signs of liquid spill, liquid penetration, or liquid damage to the computer's display assembly.</p> <p>Does the computer exhibit this type of damage?</p>	Yes	<p>Proceed with repair creation to see available options. Inform the user that computer failures due to accidental damage are not covered by Apple's one-year limited warranty or the AppleCare Protection Plan (APP).</p> <p>Refer to www.apple.com/legal/warranty for details.</p>	L90	LCD
		No	Go to step 8.	\$(nodeText.noSymptomCode)	
8.	<p>Closely examine the user's computer keyboard and top case for signs of cosmetic damage such as:</p> <ul style="list-style-type: none"> Scratches Dents <p>Does the computer exhibit this type of damage?</p>	Yes	<p>Proceed with repair creation to see available options. Inform the user that computer failures due to accidental damage are not covered by Apple's one-year limited warranty or the AppleCare Protection Plan (APP).</p> <p>Refer to www.apple.com/legal/warranty for details.</p>	K21	KEYBOARD
		No	Go to step 9.	\$(nodeText.noSymptomCode)	
9.	<p>Closely examine the user's computer keyboard and top case for signs of cosmetic damage such as:</p> <ul style="list-style-type: none"> Paint is wearing off of one or more keys on the built-in keyboard. <p>Does the computer exhibit this type of damage?</p>	Yes	<p>Proceed with repair creation to see available options. Inform the user that computer failures due to accidental damage are not covered by Apple's one-year limited warranty or the AppleCare Protection Plan (APP).</p> <p>Refer to www.apple.com/legal/warranty for details.</p>	K35	KEYBOARD
		No	Go to step 10.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
10.	<p>Closely examine the user's computer keyboard and top case for signs of liquid spill damage.</p> <p>Look for any signs of liquid spill, liquid penetration, or liquid damage to the computer's keyboard and top case.</p>	Yes	<p>Proceed with repair creation to see available options. Inform the user that computer failures due to accidental damage are not covered by Apple's one-year limited warranty or the AppleCare Protection Plan (APP).</p> <p>Refer to www.apple.com/legal/warranty for details.</p>	K90	KEYBOARD
	Does the computer exhibit this type of damage?	No	Go to step 11.	\$(nodeText.noSymptomCode)	
11.	<p>Closely examine the user's AC power adapter for signs of connector damage such as:</p> <ul style="list-style-type: none"> • Pins stuck, broken, burnt, pushed in, or bent. 	Yes	<p>Proceed with repair creation to see available options. Inform the user that computer failures due to accidental damage are not covered by Apple's one-year limited warranty or the AppleCare Protection Plan (APP).</p> <p>Refer to www.apple.com/legal/warranty for details.</p>	P15	ADAPTER
	Does the AC power adapter exhibit this type of damage?	No	Go to step 12.	\$(nodeText.noSymptomCode)	
12.	<p>Closely examine the user's AC power adapter for signs of mechanical damage such as:</p> <ul style="list-style-type: none"> • Adapter connector or cable • Adapter housing 	Yes	<p>Proceed with repair creation to see available options. Inform the user that computer failures due to accidental damage are not covered by Apple's one-year limited warranty or the AppleCare Protection Plan (APP).</p> <p>Refer to www.apple.com/legal/warranty for details.</p>	P16	ADAPTER
	Does the AC power adapter exhibit this type of damage?	No	Go to step 13.	\$(nodeText.noSymptomCode)	
13.	<p>Closely examine the user's AC power adapter for signs of cosmetic damage such as:</p> <ul style="list-style-type: none"> • Scratches • Dents 	Yes	<p>Proceed with repair creation to see available options. Inform the user that computer failures due to accidental damage are not covered by Apple's one-year limited warranty or the AppleCare Protection Plan (APP).</p> <p>Refer to www.apple.com/legal/warranty for details.</p>	P21	ADAPTER
	Does the AC power adapter exhibit this type of damage?	No	Go to step 14.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
14.	<p>Closely examine the user's AC power adapter for signs of liquid spill damage.</p> <p>Look for any signs of liquid spill, liquid penetration, or liquid damage to the user's AC power adapter.</p> <p>Does the AC power adapter exhibit this type of damage?</p>	Yes	<p>Proceed with repair creation to see available options. Inform the user that computer failures due to accidental damage are not covered by Apple's one-year limited warranty or the AppleCare Protection Plan (APP).</p> <p>Refer to www.apple.com/legal/warranty for details.</p>	P90	ADAPTER
		No	Go to step 15.	\${nodeText.noSymptomCode}	
15.	<p>Closely examine the user's USB-C charging cable and connectors for damage.</p> <p>Refer to TP1520: Visual/Mechanical Inspection (VMI) Guide for Mac Portables USB-C Cables when inspecting the user's cable.</p> <p>Does the USB-C charge cable exhibit damage according to the VMI?</p>	Yes	<p>Proceed with repair creation to see available options. Inform the user that computer failures due to accidental damage are not covered by Apple's one-year limited warranty or the AppleCare Protection Plan (APP).</p> <p>Refer to www.apple.com/legal/warranty for details.</p>	X03	EXTERNAL CABLE
		No	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for assistance with Apple-related accidental damage.</p>	\${nodeText.noSymptomCode}	

Noise, Hum, or Vibration

Unlikely causes:

AC wall adapter (duckhead), audio board, audio board flex cable, battery, bottom case, display assembly, I/O board, IPD flex cable, speakers, TCON flex cable, top case assembly, Touch ID board, trackpad, USB-C charging cable, vent / antenna module.

Quick Check

Symptoms	Quick Check
Computer or power adapter emits noise or vibration. Note: Inform user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options. Refer to OP14: Determining and quoting accidental damage for Mac portables .	Important: Disable Auto Boot before performing any troubleshooting steps that require disassembly of the computer, and reenable Auto Boot after the computer has been reassembled and service is completed. Follow steps in TP1484: Auto Boot to enable or disable this function. Note: Verify the issue after using the computer for a few minutes to warm it, or by following steps in HT207571: Warm a Mac for testing . Doing this may help identify intermittent issues. <ol style="list-style-type: none">1. Work with user to reproduce issue and isolate source of noise. Determine whether source of noise is computer or power adapter.2. If power adapter is source of noise, test with a known-good adapter. (A small amount of hum or vibration is normal for power adapters.)3. If necessary, explain to user that some noises are normal. Refer to article HT202179: About fans and fan noise in your Apple product.

Deep Dive

	Check	Result	Action	Code	Commodity
1.	Shut down the computer and let it cool off fully. Once the computer is cold, start it up and check for noise, hum, or vibration. Does issue persist during cold startup?	Yes	Go to step 2.	\$(nodeText.yesSymptomCode)	
		No	Go to step 11.	\$(nodeText.noSymptomCode)	
2.	An unreadable thermal sensor can cause a fan to run excessively. Run AST 2 Mac Resource Inspector diagnostic suite (MRI) to check thermal sensors. Does MRI report any thermal sensor failures?	Yes	Go to “Computer Runs Hot” troubleshooting flow.	\$(nodeText.yesSymptomCode)	
		No	Go to step 3.	\$(nodeText.noSymptomCode)	
3.	Excessive fan operation may also occur if computer is unable to read fan speed. Check MRI results for fan (motor) sensor test results. Does MRI report any fan (motor) failures?	Yes	Go to step 5.	\$(nodeText.yesSymptomCode)	
		No	Go to step 4.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
4.	<p>Disconnect the left fan and briefly retest for noise, hum, or vibration.</p> <p>Disconnect the right fan and briefly retest for noise, hum, or vibration.</p> <p>Has noise been eliminated?</p>	Yes	<p>Replace the fan.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>	X23	OTHER ELECTRIC
		No	Go to step 11.	\$(nodeText.noSymptomCode)	
5.	<p>Disconnect the fan flex cable connector and inspect logic board and cable connector pins for damage. Check for a damaged connector or bent pins that prevent correct seating.</p> <p>Inspect the fan flex cable for cable damage.</p> <p>Did you find damage to the fan flex cable or any connector?</p>	Yes	Go to step 6.	\$(nodeText.yesSymptomCode)	
		No	Go to step 7.	\$(nodeText.noSymptomCode)	
6.	<p>Determine whether the damage is located on the fan flex cable, the logic board, or both.</p> <p>Is the damage limited to the fan flex cable?</p>	Yes	<p>Replace the fan.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>	X23	OTHER ELECTRIC
		No	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	P99	

	Check	Result	Action	Code	Commodity
7.	Carefully reseal the fan flex cable into its connector.	Yes	Go to step 8.	\$(nodeText.yesSymptomCode)	
	Reassemble the computer and run diagnostics again. Do diagnostics still report a fan failure?	No	Issue resolved by reseating fan flex cable. Verify resolution.	\$(nodeText.noSymptomCode)	
8.	Remove the fan to reveal inner side of heat sink. Use an ESD-safe vacuum to remove dust and debris from heat sink and fan.	Yes	Go to step 9.	\$(nodeText.yesSymptomCode)	
	Reassemble the computer and run diagnostics again. Do diagnostics still report a fan failure?	No	Issue resolved by cleaning fan and heat sink. Verify resolution.	\$(nodeText.noSymptomCode)	
9.	Troubleshooting this issue completely requires a known-good fan. Do you have immediate access to a known-good fan?	Yes	Go to step 10.	\$(nodeText.yesSymptomCode)	
		No	Replace the fan. Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary. Refer to TP1314: Trackpad Calibration Check for instructions. Verify that the issue is resolved.	X23	OTHER ELECTRIC

	Check	Result	Action	Code	Commodity
10.	Substitute a known-good fan. Reassemble the computer and run diagnostics again. Do diagnostics still report a fan failure?	Yes	Reinstall the user's fan. Replace the logic board and Touch ID board. Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair. Verify that the issue is resolved.	M18	MLB
		No	Replace the fan. Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary. Refer to TP1314: Trackpad Calibration Check for instructions. Verify that the issue is resolved.	X23	OTHER ELECTRIC
11.	Substitute a known-good power adapter and retest.	Yes	Replace power adapter. Verify that the issue is resolved.	P04	ADAPTER
	Has noise been eliminated?	No	Go to step 12.	\$(nodeText.noSymptomCode)	
12.	Disconnect any peripheral devices, cards, or cables attached to computer. Has noise been eliminated?	Yes	Issue resolved. Issue caused by ground loop induced by third-party devices. Advise user to connect all devices to a common power outlet or contact device manufacturer for support.	\$(nodeText.yesSymptomCode)	
		No	Go to step 13.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
13.	<p>Noise may be related to interference from other electrical devices operating near computer or plugged into same power outlet.</p> <p>See if noise is eliminated when computer runs in a different location on a different circuit.</p> <p>Has noise been eliminated?</p>	Yes	Issue resolved. Verify resolution.	\$(nodeText.yesSymptomCode)	
		No	ESCALATION REQUIRED. Contact ACS for additional support or a multipart repair.	X99	
14.	<p>Verify that noise, hum, or vibration is resolved. There may be noise from fan and audio circuitry, but there should be no noise from the flash storage.</p> <p>If help is needed, record a sample audio file to review with ACS.</p> <p>Run AST 2 Full System diagnostic suites (EFI & OS), if available, to ensure no other issues remain.</p> <p>Is issue resolved?</p>	Yes	Issue resolved.	\$(nodeText.yesSymptomCode)	
		No	ESCALATION REQUIRED. Contact ACS for additional support or a multipart repair.	X99	

Battery Leaking or Swollen

Unlikely causes:

AC wall adapter (duckhead), audio board, audio board flex cable, bottom case, display assembly, fan, I/O board, IPD flex cable, logic board, power adapter, speakers, TCON flex cable, top case assembly, Touch ID board, trackpad, USB-C charging cable, vent / antenna module.

Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none">One or more battery cells have increased in sizeComputer wobbles and will not sit evenly on flat surfaceBottom case cannot be reinstalled <p>Note: Inform the user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options. Refer to OP14: Determining and quoting accidental damage for Mac portables.</p>	<p>Important: Disable Auto Boot before performing any troubleshooting steps that require disassembly of the computer, and reenable Auto Boot after the computer has been reassembled and service is completed. Follow steps in TP1484: Auto Boot to enable or disable this function.</p> <ol style="list-style-type: none">Check for correct installation of bottom case. An expanded battery may be preventing complete installation of the bottom case cover.Refer to OP14: Determining and quoting accidental damage for Mac portables to check for causes that would prevent correct installation of the bottom case or battery.Refer to HT204762: Enclosure separation due to expanded battery.Follow the guidelines in OP693: MacBook Air (Late 2010 and later), MacBook Pro with Retina display computers: Visual battery inspection.Follow the guidelines in OP24: Safely handling lithium batteries and lithium battery-powered devices.

Deep Dive

	Check	Result	Action	Code	Commodity
1.	Follow Service Guide procedures to remove the bottom case and disconnect the battery from the logic board.	Yes	Go step 2.	\${nodeText.yesSymptomCode}	
	<p>Inspect the battery for any sign of battery cell puncture, leakage, venting, or cell deformation.</p> <p>Refer to section five of OP24: Safely handling lithium batteries and lithium battery-powered devices, titled “Venting batteries.” Recognize battery cell electrolyte leakage.</p> <p>Apply a protective battery cover to the computer battery that is being serviced.</p> <p>If a battery cell is leaking:</p> <ol style="list-style-type: none"> 1. Keep all personnel at a safe distance to prevent persons from coming in contact with spilled material. 2. Eliminate all ignition sources and other debris (no heat sources, sparks, or flames in immediate area). <p>A leaking battery should only be handled by trained and properly equipped personnel.</p> <p>Are any battery cells punctured, leaking, or deformed?</p>	No	Go to step 3.	\${nodeText.noSymptomCode}	
2.	<p>Inspect the top case assembly for any physical damage.</p> <p>Replacement of multiple parts requires an escalation to ACS for repair approval.</p> <p>Does the top case require replacement?</p>	Yes	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	P99	
		No	<p>Replace the battery.</p> <p>Verify that the issue is resolved.</p>	P13	BATTERY

	Check	Result	Action	Code	Commodity
3.	<p>Check the battery and bottom case installation. Verify that the battery has not expanded to deform the enclosure or separate the bottom case and top case.</p> <p>One or more battery cells might have expanded, resulting in pressure on the bottom case cover.</p> <p>Refer to OP693: MacBook Air (Late 2010 and later), MacBook Pro with Retina display computers: Visual battery inspection.</p> <p>Place a protective battery cover on the computer being serviced.</p> <p>Has one or more battery cells expanded in size?</p>	Yes	Go to step 4.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 5.	`\${nodeText.noSymptomCode}`	
4.	<p>Inspect the bottom case for deformation due to battery swelling.</p> <p>Check that the bottom case can be installed correctly on new top case.</p> <p>Replacement of multiple parts requires an escalation to ACS for repair approval.</p> <p>Does the bottom case require replacement?</p>	Yes	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	P99	
		No	<p>Replace the battery.</p> <p>Verify that the issue is resolved.</p>	P13	BATTERY
5.	<p>Check with the user to determine whether battery runtime is shorter than usual.</p> <p>Is the user's battery experiencing shorter battery runtime?</p>	Yes	Go to the "Battery Runtime Too Short" troubleshooting flow.	`\${nodeText.yesSymptomCode}`	
		No	Issue cannot be duplicated.	`\${nodeText.noSymptomCode}`	
6.	<p>Run AST 2 Full System diagnostic suites (EFI & OS), if available, to ensure no other issues remain.</p> <p>Is issue resolved?</p>	Yes	The issue is resolved. Verify resolution.	`\${nodeText.yesSymptomCode}`	
		No	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	X99	

Battery Not Recognized or Does Not Charge

Unlikely causes:

AC wall adapter (duckhead), audio board, audio board flex cable, bottom case, display assembly, fan, I/O board, IPD flex cable, power adapter, speakers, TCON flex cable, top case assembly, Touch ID board, trackpad, USB-C charging cable, vent / antenna module.

Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none">• “X” in battery status menu• No lightning bolt icon in battery status menu when power adapter is connected <p>Note: Inform the user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options. Refer to OP14: Determining and quoting accidental damage for Mac portables.</p>	<p>Important: Disable Auto Boot before performing any troubleshooting steps that require disassembly of the computer, and reenable Auto Boot after the computer has been reassembled and service is completed. Follow steps in TP1484: Auto Boot to enable or disable this function.</p> <ol style="list-style-type: none">1. Verify that you are using a functional power outlet.2. Verify that the user's power adapter and charging cable are the correct models for the user's computer. Refer to HT201700: Find the right power adapter and cable for your Mac notebook. Different power adapters and USB-C charging cables may appear similar but may not provide sufficient power to turn on or charge the computer.3. Check for damage or debris in the USB-C connectors on the computer and the power adapter.4. Inspect the power adapter, connectors, AC wall adapter, and charging cable for damage such as bent plug pins, frayed or exposed wiring, or burn marks.5. Test with a known-good electrical outlet, power source, and power adapter.6. Connect the power adapter to each USB-C connector on the computer and retest each time to isolate a possible faulty USB-C port on the user's computer.7. Reset the NVRAM using the procedure for this computer in HT204063: Reset NVRAM or PRAM on your Mac.8. Reset the SMC using the procedure for this computer in HT201295: How to reset the System Management Controller (SMC) on your Mac.9. Refer to HT201260: How to find the macOS version number on your Mac to check that the system build is correct for this computer model. Check for and apply the latest software and firmware updates.10. Refer to the following articles to learn more about power-related features and functions specific to this computer that may be misinterpreted as service issues:<ul style="list-style-type: none">• HT207097: Charge your MacBook Pro with Thunderbolt 3• HT201150: How to turn your Mac on or off• HT204652: If your USB-C power adapter isn't charging your Mac notebook• HT204700: Battery may not charge or drains while using AC power

Deep Dive

	Check	Result	Action	Code	Commodity
1.	<p>Connect the user's computer to the user's power adapter and charging cable that is connected to a known-good electrical outlet.</p> <p>The computer should turn on automatically if it is off when the power adapter is connected.</p> <p>Check System Information > Power > AC Charger Information to verify that the computer recognizes the power adapter.</p> <p>Does the computer recognize the power adapter?</p>	Yes	Go to step 2.	\$(nodeText.yesSymptomCode)	
		No	Go to the "Power Adapter Issues" troubleshooting flow.	\$(nodeText.noSymptomCode)	
2.	<p>While connected to the user's power adapter and charging cable, run AST 2 Mac Resource Inspector diagnostic suite (MRI) to gather diagnostic information about the battery.</p> <p>Check MRI results for a battery failure that states "no battery detected."</p> <p>Does the computer recognize the battery?</p>	Yes	Go to step 5.	\$(nodeText.yesSymptomCode)	
		No	Go to step 3.	\$(nodeText.noSymptomCode)	
3.	<p>Troubleshooting this issue completely requires a known-good battery.</p> <p>Do you have immediate access to a known-good battery?</p>	Yes	Go to step 4.	\$(nodeText.yesSymptomCode)	
		No	<p>Replace the battery.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	P17	BATTERY

	Check	Result	Action	Code	Commodity
4.	Substitute a known-good battery.	Yes	<p>Replace the battery.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	P17	BATTERY
	<p>Verify that the battery is recognized.</p> <p>Does computer detect a known-good battery?</p>	No	<p>Reinstall the user's battery.</p> <p>Replace the logic board and Touch ID board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M20	MLB
5.	Check MRI results for any battery-specific warnings or failures.	Yes	Go to step 7.	\$(nodeText.yesSymptomCode)	
	Does MRI report any battery errors?	No	Go to step 6.	\$(nodeText.noSymptomCode)	
6.	Run Power Adapter diagnostics suite.	Yes	Go to the "Power Adapter Issues" troubleshooting flow.	\$(nodeText.yesSymptomCode)	
	<p>Power Adapter diagnostics suite may report a faulty power adapter, which could cause short battery runtimes.</p> <p>Does Power Adapter diagnostics suite report a power adapter failure?</p>	No	<p>There is no hardware issue with the battery or power adapter. Proceed with software troubleshooting. Recommend that the user refer to www.apple.com/batteries for tips to maximize battery life.</p>	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
7.	<p>Check MRI results for a consumed-battery error.</p> <p>Does MRI report a consumed battery?</p>	Yes	<p>Replace the battery.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	P19	BATTERY
		No	Go to step 8.	\${nodeText.noSymptomCode}	
8.	<p>Check the MRI results for failed (defective) battery error.</p> <p>Does MRI report a failed battery?</p>	Yes	<p>Replace the top case assembly with keyboard and trackpad.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	P19	BATTERY
		No	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	P99	
9.	<p>Verify that battery is properly charging. Charge the battery for some time. Then run the computer from the battery for only a few minutes. Reconnect the power adapter and verify that the computer correctly detects the adapter and charges the battery.</p> <p>Run AST 2 Full System diagnostic suites (EFI & OS), if available, to ensure no other issues remain.</p> <p>Is the issue resolved?</p>	Yes	The issue is resolved.	\${nodeText.yesSymptomCode}	
		No	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	X99	

Battery Runtime Too Short

Unlikely causes:

AC wall adapter (duckhead), audio board, audio board flex cable, bottom case, display assembly, fan, I/O board, IPD flex cable, logic board, power adapter, speakers, TCON flex cable, top case assembly, Touch ID board, trackpad, USB-C charging cable, vent / antenna module.

Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none">Battery runs out of power very quickly (in less than two hours).Battery runs out of power without any warning.Battery menu displays messages such as Service Battery, Replace Now, or Replace Soon. <p>Note: Inform the user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options. Refer to OP14: Determining and quoting accidental damage for Mac portables.</p>	<p>Important: Disable Auto Boot before performing any troubleshooting steps that require disassembly of the computer, and reenable Auto Boot after the computer has been reassembled and service is completed. Follow steps in TP1484: Auto Boot to enable or disable this function.</p> <ol style="list-style-type: none">Verify that the user's power adapter and charging cable are the correct models for the user's computer. Refer to HT201700: Find the right power adapter and cable for your Mac notebook. Different power adapters and USB-C charging cables may appear similar but may not provide sufficient power to turn on or charge the computer.Refer to HT201260: How to find the macOS version number on your Mac to check that the system build is correct for this computer model.Verify that applications are not forcing CPU or GPU to work overtime and consume unnecessary battery power. Refer to HT203184: See how apps affect Mac performance, battery runtime, temperature, and fan activity. To help extend battery performance, refer the user to HT204054: About Mac notebook batteries.Inspect the power adapter, connectors, AC wall adapter, and charging cable for damage such as bent plug pins, frayed or exposed wiring, or burn marks.Run AST 2 Power Adapter diagnostics with the user's power adapter connected to a known-good computer to confirm that the power adapter is functioning.Run AST 2 Power Adapter diagnostics with a known-good power adapter connected to the user's computer to confirm that the computer is functioning.Refer to the following articles to learn more information about power-related features and functions specific to this computer that may be misinterpreted as service issues:<ul style="list-style-type: none">HT207097: Charge your MacBook Pro with Thunderbolt 3HT201150: How to turn your Mac on or offHT204652: If your USB-C power adapter isn't charging your Mac notebookHT204700: Battery may not charge or drains while using AC power

Deep Dive

	Check	Result	Action	Code	Commodity
1.	While connected to the user's power adapter and charging cable, run AST 2 Mac Resource Inspector diagnostic suite (MRI) to gather diagnostic information about the battery.	Yes	Go to step 3.	\$(nodeText.yesSymptomCode)	
	Check MRI results for any battery-specific warnings or failures. Does MRI report any battery errors?	No	Go to step 2.	\$(nodeText.noSymptomCode)	
2.	Run Power Adapter diagnostics suite.	Yes	Go to the "Power Adapter Issues" troubleshooting flow.	\$(nodeText.yesSymptomCode)	
	Power Adapter diagnostics suite may report a faulty power adapter, which could cause short battery runtimes. Does Power Adapter diagnostics suite report a power adapter failure?	No	There is no hardware issue with the battery or power adapter. Proceed with software troubleshooting. Recommend that the user refer to www.apple.com/batteries for tips to maximize battery life.	\$(nodeText.noSymptomCode)	
3.	Check MRI results for a consumed battery error. Does MRI report a consumed battery?	Yes	Replace the battery. Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair. Verify that the issue is resolved.	P09	BATTERY
		No	Go to step 4.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
4.	<p>Check the MRI results for a failed (defective) battery error.</p> <p>Does MRI report a failed battery?</p>	Yes	<p>Replace the battery.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	P09	BATTERY
		No	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	P99	
5.	<p>Verify that battery runtime falls within specification.</p> <p>Run AST 2 Full System diagnostic suites (EFI & OS), if available, to ensure no other issues remain.</p> <p>Is the issue resolved?</p>	Yes	The issue is resolved.	\${nodeText.yesSymptomCode}	
		No	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	X99	

Does Not Run on Power Adapter

Unlikely causes:

AC wall adapter (duckhead), audio board, audio board flex cable, battery, bottom case, display assembly, fan, IPD flex cable, speakers, TCON flex cable, Touch ID board, trackpad, vent / antenna module.

Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none">Computer runs on battery, but not on power adapter alone. <p>Note: Inform the user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options. Refer to article OP14: Determining and quoting accidental damage for Mac portables.</p>	<p>Important: Disable Auto Boot before performing any troubleshooting steps that require disassembly of the computer, and reenable Auto Boot after the computer has been reassembled and service is completed. Follow steps in TP1484: Auto Boot to enable or disable this function.</p> <ol style="list-style-type: none">Verify that you are using a functional power outlet.Verify that the user's power adapter and charging cable are the correct models for the user's computer. Refer to HT201700: Find the right power adapter and cable for your Mac notebook. Different power adapters and USB-C charging cables may appear similar but may not provide sufficient power to turn on or charge the computer.Check for damage or debris in the USB-C connectors on the computer and the power adapter.Inspect the power adapter, connectors, AC wall adapter, and charging cable for damage such as bent plug pins, frayed or exposed wiring, or burn marks.Test with a known-good electrical outlet, power source, and power adapter.Connect the power adapter to each USB-C connector on the computer and retest each time to isolate a possible faulty USB-C port on the user's computer.Reset the NVRAM using the procedure for this computer in HT204063: Reset NVRAM or PRAM on your Mac.Reset the SMC using the procedure for this computer in HT201295: How to reset the System Management Controller (SMC) on your Mac. Retest for power issues.Refer to HT201260: How to find the macOS version number on your Mac to check that the system build is correct for this computer model.Refer to the following articles to learn more about power-related features and functions specific to this computer that may be misinterpreted as service issues:<ul style="list-style-type: none">HT207097: Charge your MacBook Pro with Thunderbolt 3HT201150: How to turn your Mac on or offHT204652: If your USB-C power adapter isn't charging your Mac notebookHT204700: Battery may not charge or drains while using AC power

Deep Dive

	Check	Result	Action	Code	Commodity
1.	<p>Inspect all USB-C ports and top case openings on the user's computer for any signs of deformation, damage, or debris that may be blocking the connection. Use compressed air to clear any obstructions or debris.</p> <p>Important: Do not use any metal objects to clear debris or obstructions, as this can short the connector and cause damage.</p> <p>Is any USB-C port damaged?</p>	Yes	Go to step 2.	\$(nodeText.yesSymptomCode}	
		No	Go to step 3.	\$(nodeText.noSymptomCode}	
2.	<p>Inspect the opening on the top case for the USB-C port. Determine whether the opening is misshapen or deformed, preventing proper insertion of the USB plugs.</p> <p>Is the opening for the USB-C port damaged or deformed?</p>	Yes	<p>Replace the top case assembly.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	K16	KEYBOARD
		No	<p>Replace the I/O board.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>	M24	OTHER BOARD

	Check	Result	Action	Code	Commodity
3.	<p>Connect the user's computer to a known-good Apple USB-C power adapter with a known-good Apple USB-C charging cable that is the correct type for the user's computer.</p> <p>Connect the power adapter to a known-good electrical outlet.</p> <p>Check that the computer recognizes the power adapter.</p> <p>The computer should turn on automatically if it is off when the power adapter is connected.</p> <p>Verify in System Information > Power > AC Charger Information that the computer recognizes the power adapter.</p> <p>Does the computer recognize the power adapter, turn on, and begin to charge?</p>	Yes	Go to step 4.	\$(nodeText.yesSymptomCode)	
		No	Go to step 5.	\$(nodeText.noSymptomCode)	
4.	<p>Shut down the computer.</p> <p>Disconnect and flip the orientation of the USB-C charging cable plug, then reconnect it to the same USB-C port on the computer and retest, to test both orientations.</p> <p>The computer should turn on automatically.</p> <p>Verify in System Information > Power > AC Charger Information that the computer recognizes the power adapter.</p> <p>Does the computer recognize the power adapter turn on?</p>	Yes	Go to the "Power Adapter Issues" troubleshooting flow.	\$(nodeText.yesSymptomCode)	
		No	Go to step 5.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
5.	Follow Service Guide procedures to remove the bottom case and disconnect the battery from the logic board.	Yes	Issue resolved by reseating the I/O board.	\$(nodeText.yesSymptomCode)	
	<p>Disconnect then reconnect the I/O board to reseat the connection to the logic board and reassemble the computer.</p> <p>Connect the user's computer to a known-good power adapter and charging cable that is connected to a known-good electrical outlet.</p> <p>The computer should turn on automatically if it is off when the power adapter is connected.</p> <p>Verify in System Information > Power > AC Charger Information that the computer recognizes the power adapter.</p> <p>Does the computer recognize the power adapter, turn on, and begin to charge?</p>	No	Go to step 6.	\$(nodeText.noSymptomCode)	
6.	<p>Troubleshooting this issue completely requires a known-good I/O board.</p> <p>Do you have immediate access to a known-good I/O board?</p>	Yes	Go to step 7.	\$(nodeText.yesSymptomCode)	
		No	<p>Replace the I/O board.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>	M21	OTHER BOARD

	Check	Result	Action	Code	Commodity
7.	<p>Substitute a known-good I/O board and reassemble the computer.</p> <p>Connect the user's computer to a known-good power adapter and charging cable that is connected to a known-good electrical outlet.</p> <p>The computer should turn on automatically if it is off when the power adapter is connected.</p> <p>Verify in System Information > Power > AC Charger Information that the computer recognizes the power adapter.</p> <p>Does the computer recognize the power adapter, turn on, and begin to charge?</p>	Yes	<p>Replace the I/O board.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>	M21	OTHER BOARD
		No	<p>Reinstall the user's I/O board.</p> <p>Replace the logic board and Touch ID board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M21	MLB
8.	<p>Verify that the computer can now detect the power adapter and that it is able to charge.</p> <p>Run AST 2 Full System diagnostic suites (EFI & OS), if available, to ensure no other issues remain.</p> <p>Is the issue resolved?</p>	Yes	The issue is resolved.	\${nodeText.yesSymptomCode}	
		No	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	X99	

Intermittent Shutdown

Unlikely causes:

AC wall adapter (duckhead), audio board, audio board flex cable, bottom case, display assembly, IPD flex cable, speakers, TCON flex cable, top case assembly, Touch ID board, trackpad, vent / antenna module.

Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none">Shuts down during startupShuts down unexpectedly during use <p>Note: Inform the user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options. Refer to OP14: Determining and quoting accidental damage for Mac portables.</p>	<p>Important: Disable Auto Boot before performing any troubleshooting steps that require disassembly of the computer, and reenable Auto Boot after the computer has been reassembled and service is completed. Follow steps in TP1484: Auto Boot to enable or disable this function.</p> <p>Note: Verify the issue after using the computer for a few minutes to warm it, or by following steps in HT207571: Warm a Mac for testing. Doing this may help identify intermittent issues.</p> <ol style="list-style-type: none">Collect the following details from the user regarding shutdown occurrence and system configuration: when shutdown occurs (for example, on battery power or after running for a while), the frequency of shutdowns, which applications are running at the time, and shutdown repeatability.Verify the battery charge and battery connection status.Unplug the power adapter from the computer, then plug the power adapter back into the computer.Check the USB-C connectors on the power adapter, computer, and charge cable for damage or debris.Hold down the Shift key during startup to put the computer into safe mode. Refer to HT201262: Use safe mode to isolate issues with your Mac.Start up the computer to macOS Recovery. See HT201314: About macOS Recovery.Reset the NVRAM using the procedure for this computer in article HT204063: Reset NVRAM or PRAM on your Mac.Reset the SMC using the procedure listed for this computer in article HT201295: How to reset the System Management Controller (SMC) on your Mac.

Deep Dive

	Check	Result	Action	Code	Commodity
1.	Power and thermal issues can cause intermittent shutdowns. Run AST 2 Mac Resource Inspector diagnostic suite (MRI) to check for problems detected by sensors.	Yes	Go to step 2.	\$(nodeText.yesSymptomCode)	
		No	Go to step 7.	\$(nodeText.noSymptomCode)	
	Does MRI report any sensor errors?				

	Check	Result	Action	Code	Commodity
2.	Identify whether MRI reports a thermal or fan sensor failure, or a voltage or current sensor failure.	Voltage/Current Sensor	Go to step 3.	`\${nodeText.yesSymptomCode}`	
	<p>There are three types of sensors that are used in the computer: voltage, current, and temperature. The sensor type is identified by the first letter in the sensor key.</p> <ul style="list-style-type: none"> Voltage sensor keys start with “V” Current sensor keys start with “I” Temperature sensor keys start with “T” <p>Which sensor failure does MRI report?</p>	Thermal/Fan Sensor	Go to the “Computer Runs Hot” troubleshooting flow.	`\${nodeText.noSymptomCode}`	
3.	<p>Verify whether any of the following sensors failed testing in diagnostics:</p> <ul style="list-style-type: none"> IAPC - WLAN (Airport) & Bluetooth current IBLR - LCD backlight current ICAC - VDD main current IC0R - CPU computing high side current IHCC - Flash storage current ID0R - DC in rail current IO3R - Other 3.3V high side current IO5R - Other 5V high side current IT3C - Trackpad & Keyboard 3.3V current VCAC - CPU IA Core voltage VD0R - DC-in voltage VP0R - PBus rail voltage VHNC - Flash Storage NAND 2.7V voltage VCIC - CPU Vcc I/O voltage <p>Did diagnostics report errors in any of the sensors listed above?</p>	Yes	<p>Replace the logic board and Touch ID board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M23	MLB
		No	Go to step 4.	`\${nodeText.noSymptomCode}`	
4.	<p>Verify whether any of the following sensors failed testing in diagnostics:</p> <ul style="list-style-type: none"> IPBR - PBus on battery current <p>Did diagnostics report errors in any of the sensors listed above?</p>	Yes	Go to step 5.	`\${nodeText.yesSymptomCode}`	
		No	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	X99	

	Check	Result	Action	Code	Commodity
5.	<p>Troubleshooting this issue completely requires a known-good battery.</p> <p>Do you have immediate access to a known-good battery?</p>	Yes	Go to step 6.	#{nodeText.yesSymptomCode}	
		No	<p>Replace the battery.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	P02	BATTERY

	Check	Result	Action	Code	Commodity
6.	Substitute a known-good battery. Run MRI again via AST 2.	Yes	<p>Replace the logic board and Touch ID board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M08	MLB
	Does MRI still indicate the same sensor error?	No	<p>Replace the battery.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	P02	BATTERY
7.	Run MRI and Power Adapter diagnostic suites.	Yes	Go to step 8.	\$(nodeText.yesSymptomCode)	
	MRI may report a consumed or defective battery. Power Adapter diagnostics may report a faulty power adapter.				
	Either issue can cause intermittent shutdowns.	No	Go to step 9.	\$(nodeText.noSymptomCode)	
	Does MRI or Power Adapter diagnostic suite report a battery or power adapter failure?				

	Check	Result	Action	Code	Commodity
8.	Specify whether MRI or Power Adapter diagnostics reported a battery error or a power adapter error.	Battery	Go to “Battery Not Recognized or Does Not Charge” troubleshooting flow.	\$(nodeText.yesSymptomCode)	
	Which component failure is reported?	Power Adapter	Go to “Does Not Run on Power Adapter” troubleshooting flow.	\$(nodeText.noSymptomCode)	
9.	Run CSD suite and check whether the computer unexpectedly shuts down.	Yes	Go to step 12.	\$(nodeText.yesSymptomCode)	
	Is the shutdown event reproducible?	No	Go to step 10.	\$(nodeText.noSymptomCode)	
10.	Check the results for Cooling System Diagnostic via AST 2 to see if any failures were recorded.	Yes	Go to the “Computer Runs Hot” troubleshooting flow.	\$(nodeText.yesSymptomCode)	
	Are any failures reported by CSD?	No	Go to step 11.	\$(nodeText.noSymptomCode)	
11.	Run Full System Diagnostic (both EFI and OS) and check whether the computer unexpectedly shuts down.	Yes	Go to step 12.	\$(nodeText.yesSymptomCode)	
	Is the shutdown event reproducible?	No	No failure was found during testing. Using correct positioning, return the computer to the user with no trouble found.	\$(nodeText.noSymptomCode)	
12.	Troubleshooting this issue completely requires a known-good logic board.	Yes	Go to step 13.	\$(nodeText.yesSymptomCode)	
	Do you have immediate access to a known-good logic board?	No	<p>Replace the logic board and Touch ID board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M08	MLB

	Check	Result	Action	Code	Commodity
13.	Substitute a known-good logic board and retest. Try to replicate the shutdown issue. Does the intermittent shutdown issue persist?	Yes	ESCALATION REQUIRED. Contact ACS for additional support or a multipart repair.	X99	
		No	Replace the logic board and Touch ID board. Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair. Verify that the issue is resolved.	M08	MLB
14.	Run Full System Diagnostic (both EFI and OS) to verify that the computer does not unexpectedly shut down. Is issue resolved?	Yes	The issue is resolved.	\${nodeText.yesSymptomCode}	
		No	ESCALATION REQUIRED. Contact ACS for additional support or a multipart repair.	X99	

Kernel Panic or System Instability

Unlikely causes:

AC wall adapter (duckhead), audio board, audio board flex cable, bottom case, fan, I/O board, IPD flex cable, power adapter, speakers, top case assembly, Touch ID board, trackpad, USB-C charging cable, vent / antenna module.

Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none">Computer restarts and displays a kernel panic alert message. Refer to HT200553: If your Mac spontaneously restarts or displays a message that it restarted or shut down because of a problem.Computer freezes during use.Computer freezes upon wake from sleep.Computer freezes when Wi-Fi is turned on or activated. <p>Note: Inform the user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options. Refer to OP14: Determining and quoting accidental damage for Mac portables.</p>	<p>Important: Disable Auto Boot before performing any troubleshooting steps that require disassembly of the computer, and reenable Auto Boot after the computer has been reassembled and service is completed. Follow steps in TP1484: Auto Boot to enable or disable this function.</p> <p>Note: Verify the issue after using the computer for a few minutes to warm it, or by following steps in HT207571: Warm a Mac for testing. Doing this may help identify intermittent issues.</p> <ol style="list-style-type: none">1. Disconnect any external peripherals.2. Hold the Shift key down during startup to put the computer into safe mode. Refer to HT201262: Use safe mode to isolate issues with your Mac.3. Follow troubleshooting in HT200553: If your Mac spontaneously restarts or displays a message that it restarted or shut down because of a problem.4. Use macOS Recovery to troubleshoot potential software issues. Hold down Command-R during startup to restart from the recovery partition. See HT201314: About macOS Recovery.5. Refer to HT201260: How to find the macOS version number on your Mac to check that the system build is correct for this computer model. Check for and apply the latest software and firmware updates.6. If the issue cannot be easily reproduced, run the Full System Diagnostic suite via AST 2 for extended testing.

Deep Dive

	Check	Result	Action	Code	Commodity
1.	Bad memory or a voltage, current, or thermal sensor error can cause kernel panics or system crashes. Run AST 2 Mac Resource Inspector diagnostic suite (MRI) or consult MRI logs to check for any sensor or memory errors.	Yes	Go to step 2.	<code>\$(nodeText.yesSymptomCode)</code>	
		No	Go to step 8.	<code>\$(nodeText.noSymptomCode)</code>	
	Does MRI report any sensor or memory errors?				

	Check	Result	Action	Code	Commodity
2.	<p>Identify the specific type of error reported in MRI: a sensor error or a memory (RAM) error.</p> <p>Which error does MRI report: sensor or memory?</p>	Sensor	Go to step 3.	`\${nodeText.yesSymptomCode}`	
		Memory	<p>Replace the logic board and Touch ID board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M06	MLB
3.	<p>Identify whether MRI reports thermal/fan sensor failure or voltage/current sensor failure.</p> <p>There are three types of sensors that are used in the computer: voltage, current, and temperature. The sensor type is identified by the first letter in the sensor key.</p> <ul style="list-style-type: none"> • Voltage sensor keys start with “V” • Current sensor keys start with “I” • Temperature sensor keys start with “T” <p>Which sensor failure does MRI report?</p>	Voltage/Current Sensor	Go to step 4.	`\${nodeText.yesSymptomCode}`	
		Thermal/Fan Sensor	Go to the “Computer Runs Hot” troubleshooting flow.	`\${nodeText.noSymptomCode}`	

	Check	Result	Action	Code	Commodity
4.	<p>Verify whether any of the following sensors failed testing in diagnostics:</p> <ul style="list-style-type: none"> • IAPC - WLAN (Airport) & Bluetooth current • IBLR - LCD backlight current • ICAC - VDD main current • ICOR - CPU computing high side current • IHCC - Flash storage current • IDOR - DC in rail current • IO3R - Other 3.3V high side current • IO5R - Other 5V high side current • IT3C - Trackpad & Keyboard 3.3V current • VCAC - CPU IA Core voltage • VDOR - DC-in voltage • VPOR - PBus rail voltage • VHNC - Flash Storage NAND 2.7V voltage • VCIC - CPU Vcc I/O voltage 	Yes	<p>Replace the logic board and Touch ID board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M23	MLB
	Did diagnostics report errors in any of the sensors listed above?	No	Go to step 5.	\$(nodeText.noSymptomCode)	
		Yes	Go to step 6.	\$(nodeText.yesSymptomCode)	
5.	<p>Verify whether any of the following sensors failed testing in diagnostics:</p> <ul style="list-style-type: none"> • IPBR - PBus on battery current 	No	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	X99	
	Did diagnostics report errors in any of the sensors listed above?				

	Check	Result	Action	Code	Commodity
6.	<p>Troubleshooting this issue completely requires a known-good battery.</p> <p>Do you have immediate access to a known-good battery?</p>	Yes	Go to step 7.	\${nodeText.yesSymptomCode}	
		No	<p>Replace the battery.</p> <p>Run AST 2 Trackpad Calibration</p> <p>Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>	P02	BATTERY

	Check	Result	Action	Code	Commodity
7.	Substitute a known-good battery.	Yes	<p>Replace the battery.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>	P02	BATTERY
	<p>Run MRI again via AST 2.</p> <p>Does MRI still indicate the same sensor error?</p>	No	<p>Replace the logic board and Touch ID board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M06	MLB
8.	Reset the SMC using the procedure for this computer in HT201295: How to reset the System Management Controller (SMC) on your Mac .	Yes	Issue resolved by resetting SMC and NVRAM. Verify resolution.	\$(nodeText.yesSymptomCode)	
	<p>Reset the NVRAM using the procedure for this computer in HT204063: Reset NVRAM or PRAM on your Mac.</p> <p>Does the computer start up and run without a kernel panic or freeze?</p>	No	Go to step 9.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
9.	<p>Use one of the following two methods to start up the computer to a known-good macOS.</p> <p>Start up the computer to macOS Recovery. See HT201314: About macOS Recovery.</p> <p>Follow steps in HT208198: About Startup Security Utility to enable starting up from an external storage device on the user's computer. Then start up the computer to a known-good external macOS startup volume.</p> <p>Attempt to reproduce the issue.</p> <p>Does the computer start up and run without a kernel panic or freeze?</p>	Yes	Go to step 12.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 10.	`\${nodeText.noSymptomCode}`	
10.	<p>Memory is built onto the logic board, therefore it is not exchangeable for testing with known-good memory. Use the memory diagnostic via AST 2 to run extended memory tests.</p> <p>Does the memory fail testing?</p>	Yes	<p>Replace the logic board and Touch ID board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M06	MLB
		No	Go to step 11.	`\${nodeText.noSymptomCode}`	

	Check	Result	Action	Code	Commodity
11.	<p>Shut down the computer and wait 30 seconds.</p> <p>Follow Service Guide procedures to remove the bottom case and disconnect the battery from the logic board.</p> <p>Disconnect the Timing Controller (TCON) flex cable connector from the logic board and display.</p> <p>Connect an external display via a USB-C video adapter. Start up the computer and retest.</p> <p>Does the kernel panic or crash still occur?</p>	Yes	<p>Replace the logic board and Touch ID board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M06	MLB
		No	Go to step 16.	\$(nodeText.noSymptomCode)	
12.	<p>Run MRI and Storage Diagnostic via AST 2 to verify the functionality of the built-in flash storage.</p> <p>Check only for hardware errors reported by diagnostics, not software or file system errors.</p> <p>Are any hardware issues detected in the flash storage?</p>	Yes	<p>Replace the logic board and Touch ID board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M06	MLB
		No	Go to step 13.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
13.	<p>Use the results from AST 2 diagnostics to determine the macOS build version that is installed on the computer.</p> <p>Refer to HT201260: How to find the macOS version number on your Mac to check that the system build is correct for this computer model.</p> <p>Is the correct version of macOS installed on the user's drive?</p>	Yes	Go to step 14.	`\${nodeText.yesSymptomCode}`	
		No	<p>Reinstall macOS on the user's computer.</p> <p>Check for and apply the latest software and firmware updates.</p> <p>Verify that the issue is resolved.</p>	`\${nodeText.noSymptomCode}`	
14.	<p>Use one of the following two methods to start up the computer to a known-good macOS.</p> <p>Start up the computer to macOS Recovery. See HT201314: About macOS Recovery.</p> <p>Follow steps in HT208198: About Startup Security Utility to enable starting up from an external storage device on the user's computer. Then start up the computer to a known-good external macOS startup volume.</p> <p>Use Disk Utility to repair the user's internal flash storage volume.</p> <p>Attempt to start up the user's computer from its internal flash storage.</p> <p>Does a kernel panic or crash still occur?</p>	Yes	Go to step 15.	`\${nodeText.yesSymptomCode}`	
		No	The issue is resolved. Verify resolution.	`\${nodeText.noSymptomCode}`	

	Check	Result	Action	Code	Commodity
15.	<p>Follow all steps in HT204743: Partition a problematic drive two times before recommending service or replacement.</p> <p>This will force a rewrite of the partition table.</p> <p>Reinstall macOS on the user's computer. Refer to HT201260: How to find the macOS version number on your Mac to check that the system build is correct for this computer model. Check for and apply the latest software and firmware updates. Verify that the issue is resolved.</p> <p>Does a kernel panic or crash still occur?</p>	Yes	<p>Replace the logic board and Touch ID board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M06	MLB
		No	The issue is resolved. Verify resolution.	\$(nodeText.noSymptomCode)	
16.	<p>Inspect the TCON flex cable for damage. Look for pinching or crimping, and damaged or bent pins.</p> <p>Does the TCON flex cable show signs of damage?</p>	Yes	Go to step 17.	\$(nodeText.yesSymptomCode)	
		No	Go to step 18.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
17.	Inspect the logic board and display TCON flex connectors for damage. Is the connector on the logic board or display also damaged?	Yes	ESCALATION REQUIRED. Contact ACS for additional support or a multipart repair.	X99	
		No	Replace the TCON flex cable. Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary. Refer to TP1314: Trackpad Calibration Check for instructions. Verify that the issue is resolved.	X03	INTERNAL CABLE
18.	Inspect the logic board TCON connector for damage. Does the connector on the logic board show signs of damage?	Yes	Replace the logic board and Touch ID board. Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair. Verify that the issue is resolved.	M24	MLB
		No	Go to step 19.	\${nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
19.	<p>Inspect the display TCON connector for damage.</p> <p>Does the connector on the display show signs of damage?</p>	Yes	<p>Replace the display assembly.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	L14	LCD
		No	Go to step 20.	\$(nodeText.noSymptomCode)	
20.	<p>Reseat the TCON flex cable connectors on the logic board and display.</p> <p>Reassemble the computer and retest for kernel panics.</p> <p>An NVRAM reset may be required if the brightness was lowered during troubleshooting.</p> <p>Does the kernel panic or crash still occur?</p>	Yes	Go to step 21.	\$(nodeText.yesSymptomCode)	
		No	<p>The issue was resolved by reseating the TCON flex cable.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
21.	<p>Troubleshooting this issue completely requires a known-good TCON flex cable.</p> <p>Do you have immediate access to a known-good TCON flex cable?</p>	Yes	Go to step 22.	#{nodeText.yesSymptomCode}	
		No	<p>Replace the TCON flex cable.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>	X03	INTERNAL CABLE
22.	<p>Substitute a known-good TCON flex cable and retest for kernel panics.</p> <p>Does the kernel panic or crash still occur?</p>	Yes	Go to step 23.	#{nodeText.yesSymptomCode}	
		No	<p>Replace the TCON flex cable.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>	X03	INTERNAL CABLE

	Check	Result	Action	Code	Commodity
23.	Reinstall the user's TCON flex cable. Troubleshooting this issue completely requires a known-good display assembly. Do you have immediate access to a known-good display assembly?	Yes	Go to step 24.	<code>\${nodeText.yesSymptomCode}</code>	
		No	Replace the display assembly. Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair. Verify that the issue is resolved.	L37	LCD

	Check	Result	Action	Code	Commodity
24.	Substitute a known-good display assembly and and retest for kernel panics. Does the kernel panic or crash still occur?	Yes	Reinstall the user's display assembly. Replace the logic board and Touch ID board. Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair. Verify that the issue is resolved.	M06	MLB
		No	Replace the display assembly. Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair. Verify that the issue is resolved.	L37	LCD

	Check	Result	Action	Code	Commodity
25.	Run full system diagnostics via AST 2 and verify that the system is stable with extended use, making sure the computer does not encounter a crash or kernel panic. Is the issue resolved?	Yes	The issue is resolved. Verify resolution.	\${nodeText.yesSymptomCode}	
		No	ESCALATION REQUIRED. Contact ACS for additional support or a multipart repair.	X99	

No Auto Boot

Unlikely causes:

AC wall adapter (duckhead), audio board, audio board flex cable, battery, bottom case, display assembly, fan, I/O board, IPD flex cable, logic board, power adapter, speakers, TCON flex cable, top case assembly, Touch ID board, trackpad, USB-C charging cable, vent / antenna module.

Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none">• Computer does not start up when display is opened, as expected.• Computer does not start up from shutdown when power adapter is attached, as expected. <p>Note: Inform the user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options. Refer to OP14: Determining and quoting accidental damage for Mac portables.</p>	<ol style="list-style-type: none">1. These features are supported on this Apple notebook computer; however not all Apple notebook computers support these startup features.2. Verify that you are using a functional power outlet.3. Inspect the power adapter, connectors, AC wall adapter, and charging cable for damage such as bent plug pins, frayed or exposed wiring, or burn marks.4. Verify that the user's power adapter and charging cable are the correct models for the user's computer. Refer to HT201700: Find the right power adapter and cable for your Mac notebook. Different power adapters and USB-C charging cables may appear similar but may not provide sufficient power to turn on or charge the computer.5. Test the user's power cord or AC wall adapter with a known-good power adapter.6. Test the user's power adapter with a known-good power cord or AC wall adapter.7. Connect the power adapter to each USB-C connector on the computer and retest each time to isolate a possible faulty USB-C port on the user's computer.8. Verify that the user's computer display can open and close freely and completely with no difficulty. Refer to TP1138: Visual/Mechanical Inspection (VMI) Guide for Mac Displays for guidance regarding possible damage to the user's computer display.9. Refer to HT201150: How to turn your Mac on or off for more information about these features and how they are intended to work with this computer.

Deep Dive

	Check	Result	Action	Code	Commodity
1.	<p>Follow Service Guide steps to reenable Boot on Lid Open feature.</p> <p>Follow steps in TP1484: Auto Boot to retest that this feature has been reenabled and is functioning properly.</p> <p>Does the computer now start up when the display is opened?</p>	Yes	Go to step 2.	`\${nodeText.yesSymptomCode}`	
		No	Go to the “Will Not Start Up” troubleshooting flow.	`\${nodeText.noSymptomCode}`	
2.	<p>Follow Service Guide steps to reenable Boot from Shutdown on AC Attach feature.</p> <p>Follow steps in TP1484: Auto Boot to retest that this feature has been reenabled and is functioning properly.</p> <p>Does the computer now start up when the power adapter is attached?</p>	Yes	The issue is resolved.	`\${nodeText.yesSymptomCode}`	
		No	Go to the “Power Adapter Issues” troubleshooting flow.	`\${nodeText.noSymptomCode}`	

No Power

Unlikely causes:

Audio board, audio board flex cable, bottom case, display assembly, fan, IPD flex cable, speakers, TCON flex cable, Touch ID board, trackpad, vent / antenna module.

Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none"> • Computer does not turn on • No image on display and no Caps Lock light when key is pressed <p>Note: Inform the user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options. Refer to OP14: Determining and quoting accidental damage for Mac portables.</p>	<p>Important: Disable Auto Boot before performing any troubleshooting steps that require disassembly of the computer, and reenable Auto Boot after the computer has been reassembled and service is completed. Follow steps in TP1484: Auto Boot to enable or disable this function.</p> <ol style="list-style-type: none"> 1. After logic board replacement, if the computer does not turn on, this could mean that the replacement logic board has not yet been configured for use. For complete instructions to configure a replacement logic board, refer to TP1657: System Configuration. Always complete all applicable procedures and diagnostic suites after part replacement, to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair. 2. Verify that you are using a functional power outlet. 3. Verify that the user's power adapter and charging cable are the correct models for the user's computer. Refer to HT201700: Find the right power adapter and cable for your Mac notebook. Different power adapters and USB-C charging cables may appear similar but may not provide sufficient power to turn on or charge the computer. 4. Check for damage or debris in the USB-C connectors on the computer and the power adapter. 5. Inspect the power adapter, connectors, AC wall adapter, and charging cable for damage such as bent plug pins, frayed or exposed wiring, or burn marks. 6. Test with a known-good electrical outlet, power source, power adapter, and charging cable that is the correct type for the user's computer. 7. Connect the power adapter to each USB-C connector on the computer and retest each time to isolate a possible faulty USB-C port on the user's computer. 8. Disconnect all peripherals. 9. Determine whether the computer has power by confirming that any of the following function correctly: <ul style="list-style-type: none"> • Trackpad clicks when pressed • Power connection feedback occurs • Caps Lock key light turns on when pressed • Display activity functions • Keyboard backlight turns on with ambient light change or when the sensor is covered up • An external display functions 10. Verify that Auto Boot is enabled. If Auto Boot is disabled then the computer will not automatically turn on when the power adapter is connected as expected. Refer to TP1484: Auto Boot for instructions. 11. Follow suggested steps in HT204267: If your Mac won't turn on. 12. Reset the SMC using the procedure for this computer in HT201295: How to reset the System Management Controller (SMC) on your Mac, then try to turn on the computer. 13. Refer to the following articles to learn more information about power-related features and functions specific to this computer that may be misinterpreted as service issues: <ul style="list-style-type: none"> • HT207097: Charge your MacBook Pro with Thunderbolt 3 • HT201150: How to turn your Mac on or off • HT204652: If your USB-C power adapter isn't charging your Mac notebook • HT204700: Battery may not charge or drains while using AC power

Deep Dive

	Check	Result	Action	Code	Commodity
1.	Connect the user's computer to the user's power adapter and charging cable that is connected to a known-good electrical outlet.	Yes	Go to step 2.	`\${nodeText.yesSymptomCode}`	
	The computer should turn on automatically if it is off when the power adapter is connected.				
	Check for any signs of power, such as Caps Lock LED illumination, or keyboard backlight.	No	Go to step 4.	`\${nodeText.noSymptomCode}`	
	Does computer show any signs of power activity?				
2.	Check for a video signal on the built-in display.	Yes	Issue cannot be duplicated.	`\${nodeText.yesSymptomCode}`	
	Is a video image clearly visible on the built-in display?	No	Go to step 3.	`\${nodeText.noSymptomCode}`	
3.	Use a flashlight at a steep angle to the display to check for video output without the backlight.	Yes	Go to the "Backlight Issues or No Backlight" troubleshooting flow.	`\${nodeText.yesSymptomCode}`	
	Is any video visible with the flashlight?	No	Go to the "Power But No Video" troubleshooting flow.	`\${nodeText.noSymptomCode}`	
4.	Inspect the user's power adapter and AC wall adapter for damage.	Yes	Go to the "Mechanical, Physical, or Cosmetic Damage" troubleshooting flow.	`\${nodeText.yesSymptomCode}`	
	Check the USB-C ports on the user's power adapter and computer for contamination, debris, or damaged pins.				
	Inspect the user's USB-C charging cable and connectors for damage.				
	Refer to TP1520: Visual/Mechanical Inspection (VMI) Guide for Mac Portables USB-C Cables when inspecting the user's cable.	No	Go to step 5.	`\${nodeText.noSymptomCode}`	
	Does the user's power adapter, USB-C charge cable, or AC wall adapter appear damaged?				

	Check	Result	Action	Code	Commodity
5.	<p>Inspect all USB-C ports and top case openings on the user's computer for any signs of deformation, damage, or debris that may be blocking the connection. Use compressed air to clear any obstructions or debris.</p> <p>Important: Do not use any metal objects to clear debris or obstructions, as this can short the connector and cause damage.</p> <p>Is any USB-C port damaged?</p>	Yes	Go to step 6.	#{nodeText.yesSymptomCode}	
		No	Go to step 7.	#{nodeText.noSymptomCode}	
6.	<p>Inspect the opening on the top case for the USB-C port. Determine whether the opening is misshapen or deformed, preventing proper insertion of the USB plugs.</p> <p>Is the opening for the USB-C port damaged or deformed?</p>	Yes	<p>Replace the top case assembly.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	K16	KEYBOARD
		No	<p>Replace the I/O board.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>	M24	OTHER BOARD

	Check	Result	Action	Code	Commodity
7.	Substitute the user's AC wall adapter (duckhead) or power cord for a known-good AC wall adapter or power cord.	Yes	Replace the power cord or AC wall adapter (duckhead). Verify that the issue is resolved.	X03	EXTERNAL CABLE
	Attempt normal startup again.				
	Does the computer turn on with a known-good AC wall adapter or power cord?	No	Go to step 8.	\$(nodeText.noSymptomCode)	
8.	Substitute a known-good, compatible power adapter.	Yes	Replace the power adapter. Verify that the issue is resolved.	P23	ADAPTER
	Attempt normal startup again.				
	Does the computer turn on with a known-good power adapter?	No	Go to step 9.	\$(nodeText.noSymptomCode)	
9.	Substitute a known-good, USB-C charging cable that is the correct type for the user's computer.	Yes	Replace the USB-C charging cable. Verify that the issue is resolved.	X03	EXTERNAL CABLE
	Attempt normal startup again.				
	Does the computer turn on with a known-good charging cable?	No	Go to step 10.	\$(nodeText.noSymptomCode)	
10.		Yes	Go to step 11.	\$(nodeText.yesSymptomCode)	
	Unplug the charging cable from the computer.				
	Follow Service Guide procedures to remove the bottom case and disconnect the battery from the logic board.				
	Attempt normal startup again.	No	Replace the logic board and Touch ID board.		
	Does the computer turn on when the battery is disconnected?		Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.	M01	MLB
			Verify that the issue is resolved.		

	Check	Result	Action	Code	Commodity
11.	<p>Troubleshooting this issue completely requires a known-good battery.</p> <p>Do you have immediate access to a known-good battery?</p>	Yes	Go to step 12.	`\${nodeText.yesSymptomCode}`	
		No	<p>Replace the battery.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>	P01	BATTERY

	Check	Result	Action	Code	Commodity
12.	Substitute a known-good battery. Attempt normal startup again. Does the computer turn on and attempt startup?	Yes	Reinstall the user's top case assembly. Replace the logic board and Touch ID board. Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair. Verify that the issue is resolved.	M01	MLB
		No	Replace the battery. Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary. Refer to TP1314: Trackpad Calibration Check for instructions. Verify that the issue is resolved.	P01	BATTERY
13.	Verify that the computer can now complete the startup process over multiple trials. Run AST 2 Full System diagnostic suites (EFI & OS), if available, to ensure no other issues remain. Is the issue resolved?	Yes	The issue is resolved.	\${nodeText.yesSymptomCode}	
		No	ESCALATION REQUIRED. Contact ACS for additional support or a multipart repair.	X99	

Power Adapter Issues

Unlikely causes:

AC wall adapter (duckhead), Audio board, audio board flex cable, battery, bottom case, display assembly, fan, I/O board, IPD flex cable, logic board, power adapter, speakers, TCON flex cable, top case assembly, Touch ID board, trackpad, USB-C charging cable, vent / antenna module.

Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none">No power connection feedbackBattery not charging <p>Note: Inform the user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options. Refer to OP14: Determining and quoting accidental damage for Mac portables.</p>	<p>Important: Disable Auto Boot before performing any troubleshooting steps that require disassembly of the computer, and reenable Auto Boot after the computer has been reassembled and service is completed. Follow steps in TP1484: Auto Boot to enable or disable this function.</p> <ol style="list-style-type: none">Verify that you are using a functional power outlet.Verify that the user's power adapter and charging cable are the correct models for the user's computer. Refer to HT201700: Find the right power adapter and cable for your Mac notebook. Different power adapters and USB-C charging cables may appear similar but may not provide sufficient power to turn on or charge the computer.Reset the SMC using the procedure for this computer in HT201295: How to reset the System Management Controller (SMC) on your Mac.Check for debris or broken pins on both plugs of the USB-C charging cable. Clean any debris from the plugs accordingly.Connect the user's power adapter to a known-good computer and run AST 2 Power Adapter Diagnostic suite to confirm that the power adapter is functioning. <p>Warning: If a power cord or AC wall adapter is damaged, do not connect it to power.</p> <ol style="list-style-type: none">If the battery is drained on the user's computer, connect it to a known-good power adapter with a known-good charging cable and charge the computer for up to 10 minutes to verify that the computer's battery can charge. If the user's computer does not charge with a known-good power adapter, return to the list of symptoms and select "Battery Not Recognized or Does Not Charge" from the troubleshooting menu.Refer to the following articles to learn more information about power-related features and functions specific to this computer that may be misinterpreted as service issues:<ul style="list-style-type: none">HT207097: Charge your MacBook Pro with Thunderbolt 3HT201150: How to turn your Mac on or offHT204652: If your USB-C power adapter isn't charging your Mac notebookHT204700: Battery may not charge or drains while using AC power

Deep Dive

	Check	Result	Action	Code	Commodity
1.	Inspect the user's power adapter and AC wall adapter for damage.	Yes	Go to the "Mechanical, Physical, or Cosmetic Damage" troubleshooting flow.	\${nodeText.yesSymptomCode}	
	Check the USB-C ports on the user's power adapter and computer for contamination, debris, or damaged pins.				
	Inspect the user's USB-C charging cable and connectors for damage.	No	Go to step 2.	\${nodeText.noSymptomCode}	
	Refer to TP1520: Visual/Mechanical Inspection (VMI) Guide for Mac Portables USB-C Cables when inspecting the user's cable.				
2.	Does the user's power adapter, USB-C charge cable, or AC wall adapter appear damaged?	Yes	Go to step 3.	\${nodeText.yesSymptomCode}	
	Inspect all USB-C ports and top case openings on the user's computer for any signs of deformation, damage, or debris that may be blocking the connection. Use compressed air to clear any obstructions or debris.				
	Important: Do not use any metal objects to clear debris or obstructions, as this can short the connector and cause damage.	No	Go to step 4.	\${nodeText.noSymptomCode}	
	Is any USB-C port damaged?				

	Check	Result	Action	Code	Commodity
3.	Inspect the opening on the top case for the USB-C port. Determine whether the opening is misshapen or deformed, preventing proper insertion of the USB plugs.	Yes	<p>Replace the top case assembly.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	K16	KEYBOARD
	Is the opening for the USB-C port damaged or deformed?	No	<p>Replace the I/O board.</p> <p>Run AST 2 Trackpad Calibration Check suite to verify the proper functionality of the trackpad, as well as recalibrate it if necessary.</p> <p>Refer to TP1314: Trackpad Calibration Check for instructions.</p> <p>Verify that the issue is resolved.</p>	M24	OTHER BOARD
4.	Connect the user's computer to a known-good power adapter and charging cable that is connected to a known-good electrical outlet.	Yes	Go to step 5.	\${nodeText.yesSymptomCode}	
	<p>The computer should turn on automatically if it is off when the power adapter is connected.</p> <p>Verify that the computer turns on and charges.</p> <p>Does the computer turn on and charge?</p>	No	Go to the "No Power" troubleshooting flow.	\${nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
5.	Check System Information > Power > AC Charger Information to verify that the computer recognizes the known-good power adapter.	Yes	Go to step 6.	`\${nodeText.yesSymptomCode}`	
	Then substitute the user's power adapter and recheck System Information > Power > AC Charger Information to verify that the computer recognizes the user's power adapter.	No	Replace the power adapter. Verify that the issue is resolved.	P23	ADAPTER
	Does the computer recognize the user's power adapter?				
6.	Substitute the user's charging cable with the known-good power adapter.	Yes	Go to step 7.	`\${nodeText.yesSymptomCode}`	
	Verify that the computer turns on and charges.	No	Replace the USB-C charging cable. Verify that the issue is resolved.	X03	EXTERNAL CABLE
	Does the computer recognize the user's USB-C charging cable?				
7.	Run AST 2 Power Adapter diagnostic suite on the user's computer with the user's power adapter and charging cable connected to confirm that the user's power adapter and charging cable are both functioning.	Yes	Issue cannot be duplicated.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 8.	`\${nodeText.noSymptomCode}`	
	Does the computer pass all tests?				
8.	Substitute the user's AC wall adapter (duckhead) or power cord for a known-good AC wall adapter or power cord.	Yes	Replace the power cord or AC wall adapter (duckhead). Verify that the issue is resolved.	X03	EXTERNAL CABLE
	Attempt normal startup again.				
	Does the computer pass all tests?	No	Go to step 9.	`\${nodeText.noSymptomCode}`	
9.	Substitute a known-good, compatible power adapter.	Yes	Replace the power adapter. Verify that the issue is resolved.	P23	ADAPTER
	Attempt normal startup again.				
	Do all tests pass?	No	Replace the USB-C charging cable. Verify that the issue is resolved.	X03	EXTERNAL CABLE

	Check	Result	Action	Code	Commodity
10.	<p>Verify that the computer can now charge.</p> <p>Run AST 2 Full System diagnostic suites (EFI & OS), if available, to ensure no other issues remain.</p> <p>Is the issue resolved?</p>	Yes	The issue is resolved.	\${nodeText.yesSymptomCode}	
		No	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	X99	

Will Not Start Up

Unlikely causes:

AC wall adapter (duckhead), Audio board, audio board flex cable, battery, bottom case, display assembly, fan, I/O board, IPD flex cable, power adapter, speakers, TCON flex cable, top case assembly, Touch ID board, trackpad, USB-C charging cable, vent / antenna module.

Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none">• Blank black screen with backlight• Some video activity, Apple logo, progress bar• Prohibitory sign or folder with flashing question mark• Error beep tones• Caps Lock key light toggles on and off when Caps Lock key pressed <p>Note: Inform the user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options. Refer to article OP14: Determining and quoting accidental damage for Mac portables.</p>	<p>Important: Disable Auto Boot before performing any troubleshooting steps that require disassembly of the computer, and reenable Auto Boot after the computer has been reassembled and service is completed. Follow steps in TP1484: Auto Boot to enable or disable this function.</p> <ol style="list-style-type: none">1. In the event that there is an iBridge/macOS version mismatch in the user's computer, iBridge firmware will update automatically while the computer is connected to the Internet. During this process, the computer's display can remain completely black for at least 30 seconds. If the computer is turned off or disconnected from the Internet during this process under the assumption that something went wrong, the black screen will occur again until the iBridge update has completed. To resolve this issue, plug in the computer, attempt to turn it on, then wait at least one minute to provide an opportunity for any updates to complete if needed. Once completed, the computer should display video once again.2. After logic board replacement, if the computer turns on but displays only a black screen and does not start up, this could mean that the replacement logic board has not yet been configured for use. For complete instructions to configure a replacement logic board, refer to TP1657: System Configuration. Always complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.3. Use macOS Recovery to troubleshoot potential software issues. Press and hold Command-R during startup to restart from the recovery partition. See HT201314: About macOS Recovery.4. Refer to HT201260: How to find the macOS version number on your Mac to make sure system build is correct for this computer model. Check for and apply the latest software and firmware updates. Remember that third-party software can contribute to this issue. It may be necessary to check for and apply third-party updates that may not appear in the App Store.5. Verify that startup process passes initial memory checks and POST (Power-On Self-Test) with some video activity. If computer generates beeping sounds, there may be an issue with memory. See HT201702: About Mac Power On Self Test (POST) RAM error codes.6. Try to determine what the computer was doing during startup. Refer to HT204156: About the screens you see when your Mac starts up.7. Follow suggested steps in HT206182: Helping customers with a Mac that doesn't start up.8. Follow suggested steps in HT204463: If the fans in your Mac run at full speed when you turn it on.9. Hold down the Shift key during startup to put the computer into safe mode. Refer to HT201262: Use safe mode to isolate issues with your Mac.10. Reset the SMC using the procedure listed for this computer in HT201295: How to reset the System

	<p>Management Controller (SMC) on your Mac.</p> <ol style="list-style-type: none"> Reset the NVRAM using the procedure for this computer in HT204063: How to Reset NVRAM or PRAM on your Mac. Start up from Mac Resource Inspector diagnostic suite (MRI), check for the presence of an installed macOS, then refer to HT201260: How to find the macOS version number on your Mac to check that the system build is correct for this computer model. If the battery is drained on the user's computer, connect it to a known-good power adapter with a known-good charging cable and charge the computer for up to 10 minutes to verify that the computer's battery can charge. If the user's computer does not charge with a known-good power adapter, return to the list of symptoms and select the "Battery Not Recognized or Does Not Charge" troubleshooting flow. Refer to the following articles to learn more information about power-related features and functions specific to this computer that may be misinterpreted as service issues: <ul style="list-style-type: none"> HT207097: Charge your MacBook Pro with Thunderbolt 3 HT201150: How to turn your Mac on or off HT204652: If your USB-C power adapter isn't charging your Mac notebook HT204700: Battery may not charge or drains while using AC power
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Deep Dive

	Check	Result	Action	Code	Commodity
1.	Connect the user's computer to the user's power adapter and charging cable that is connected to a known-good electrical outlet.	Yes	Go to step 2.	\$(nodeText.yesSymptomCode)	
	<p>The computer should turn on automatically if it is off when the power adapter is connected.</p> <p>Check for any signs of power by confirming that any of the following function correctly:</p> <ul style="list-style-type: none"> Trackpad clicks when pressed Power connection feedback occurs Caps Lock key light turns on when Caps Lock key pressed Display activity functions Keyboard backlight turns on with ambient light change or when the sensor is covered up An external display functions <p>Does computer show any sign of power activity?</p>	No	Go to the "No Power" troubleshooting flow.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
2.	Disconnect any external peripherals.	Yes	Go to step 4.	\$(nodeText.yesSymptomCode}	
	<p>Reset the NVRAM using the procedure for this computer in HT204063: Reset NVRAM or PRAM on your Mac.</p> <p>Check for any signs that the computer is starting up.</p> <p>Can you confirm that the computer is starting up?</p>	No	Go to step 3.	\$(nodeText.noSymptomCode}	
3.		Yes	Go to “Power But No Video” troubleshooting flow.	\$(nodeText.yesSymptomCode}	
	<p>Shut down the computer and wait 30 seconds.</p> <p>Follow Service Guide procedures to remove the bottom case and disconnect the battery from the logic board.</p> <p>Disconnect the Timing Controller (TCON) flex cable connector from the logic board and display.</p> <p>Connect an external display via a USB-C video adapter. Start up the computer and retest.</p> <p>Does the computer start up with the built-in display disconnected?</p>	No	<p>Replace the logic board and Touch ID board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M02	MLB
4.	Press and hold the Option or Alt key to start up the computer. Observe the startup process to verify that the computer boots to Startup Manager.	Yes	Go to step 5.	\$(nodeText.yesSymptomCode}	
	<p>The startup will show, at a minimum, a black screen with a mouse cursor.</p> <p>Does the computer boot to Startup Manager?</p>	No	Go to “Power But No Video” troubleshooting flow.	\$(nodeText.noSymptomCode}	
5.	Start up the computer and determine whether a kernel panic is occurring.	Yes	Go to the “Kernel Panic or System Instability” troubleshooting flow.	\$(nodeText.yesSymptomCode}	
	<p>Refer to HT200553: If your Mac spontaneously restarts or displays a message that it restarted or shut down because of a problem.</p> <p>Does the computer display a kernel panic during startup?</p>	No	Go to step 6.	\$(nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
6.	Use one of the following two methods to start up the computer to a known-good macOS.	Yes	Go to step 9.	\${nodeText.yesSymptomCode}	
	<p>Start up the computer to macOS Recovery. See HT201314: About macOS Recovery.</p> <p>Follow steps in HT208198: About Startup Security Utility to enable starting up from an external storage device on the user's computer. Then start up the computer to a known-good external macOS startup volume.</p> <p>During startup, allow up to four minutes for a defective flash storage to time out, after which the computer will start up from a known-good external device.</p> <p>Does the computer start up from a known-good volume?</p>	No	Go to step 7.	\${nodeText.noSymptomCode}	
7.	<p>Follow Service Guide procedures to remove the bottom case and disconnect the battery from the logic board.</p> <p>Inspect all internal cables and connectors for damage.</p> <p>Are any internal cables or connectors damaged?</p>	Yes	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	X99	
		No	Go to step 8.	\${nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
8.	<p>Reseat the internal connections and reassemble the computer.</p> <p>Attempt a normal startup.</p> <p>Does the computer start up?</p>	Yes	The issue was resolved by reseating the internal connections. Verify resolution.	`\${nodeText.yesSymptomCode}`	
		No	<p>Replace the logic board and Touch ID board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M02	MLB
9.	<p>Run AST 2 MRI and Storage Diagnostic suites to verify the functionality of the built-in flash storage.</p> <p>Check only for hardware errors reported by diagnostics. Do not check for software or file system errors.</p> <p>Are any hardware issues detected in the flash storage?</p>	Yes	<p>Replace the logic board and Touch ID board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M43	MLB
		No	Go to step 10.	`\${nodeText.noSymptomCode}`	

	Check	Result	Action	Code	Commodity
10.	Use the results from AST 2 diagnostics to determine the macOS build version that is installed on the computer.	Yes	Go to step 11.	\$(nodeText.yesSymptomCode}	
	Refer to HT201260: How to find the macOS version number on your Mac to check that the system build is correct for this computer model. Is the correct version of macOS installed on the user's drive?	No	Reinstall macOS on the user's computer. Check for and apply the latest software and firmware updates. Verify that the issue is resolved.	\$(nodeText.noSymptomCode}	
11.	Use one of the following two methods to start up the computer to a known-good macOS.	Yes	The issue is resolved. Verify resolution.	\$(nodeText.yesSymptomCode}	
	Start up the computer to macOS Recovery. See HT201314: About macOS Recovery . Follow steps in HT208198: About Startup Security Utility to enable starting up from an external storage device on the user's computer. Then start up the computer to a known-good external macOS startup volume. Use Disk Utility to repair the user's internal flash storage volume. Attempt to start up the user's computer from its internal flash storage. Does the computer start up successfully from its internal flash storage?	No	Go to step 12.	\$(nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
12.	<p>Follow all steps in HT204743: Partition a problematic drive two times before recommending service or replacement.</p> <p>This will force a rewrite of the partition table.</p> <p>Reinstall macOS on the user's computer. Refer to HT201260: How to find the macOS version number on your Mac to check that the system build is correct for this computer model. Check for and apply the latest software and firmware updates. Verify that the issue is resolved.</p> <p>Does the computer start up successfully from its internal flash storage?</p>	Yes	The issue is resolved. Verify resolution.	\$(nodeText.yesSymptomCode)	
		No	<p>Replace the logic board and Touch ID board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.</p> <p>Verify that the issue is resolved.</p>	M44	MLB
13.	<p>Verify that the computer can now complete the startup process over multiple trials.</p> <p>Run AST 2 Full System diagnostic suites (EFI & OS), if available, to ensure no other issues remain.</p> <p>Is the issue resolved?</p>	Yes	The issue is resolved.	\$(nodeText.yesSymptomCode)	
		No	<p>ESCALATION REQUIRED.</p> <p>Contact ACS for additional support or a multipart repair.</p>	X99	

About Apple service certifications

Topic

To learn more about accessing [ATLAS](#) and service exams, review these articles:

- [How to get a Tech ID](#)
- [ATLAS frequently asked questions](#)
- [How to access Apple service exams at Pearson VUE](#)
- Certifications Explained Video - ([SV370](#)) for AASPs, ([SV371](#)) for Apple Store employees.

Note: Apple Store employees must read [Understanding Exam and Certification requirements](#) (RS228), in addition to this procedure.

Exams and courses that you need to service iOS products

Training for Apple Certified iOS Technician (ACiT) 2018 is available to technicians who work at Apple-authorized service facilities. Technicians need a Global Service Exchange (GSX) account to see the courses in [ATLAS](#).

To register for any ACiT exam, use [Pearson VUE](#).

ACiT 2018 certification

With ACiT 2018 certification, you can service iOS devices such as iPhone and iPad after passing the following exams:

- Apple Service Fundamentals Exam (SVC-18A) or (SVC-17A)
- ACiT 2018 iOS Service Certification Exam (iOS-18A)

Please note that the following devices have additional requirements:

- iPad Pro 12.9-inch (3rd generation), iPad Pro 11.0-inch
 - Also complete the Troubleshooting iPad course ([PQ-054](#)) in ATLAS.
- iPhone XS and iPhone XS Max:
 - Also complete the iPhone XS and iPhone XS Max Product Qualification ([PQ-045](#)) and iPhone Display Adhesive Product Qualification ([PQ-053](#)) courses in ATLAS.
- iPhone XR:
 - Also complete the iPhone XR Product Qualification ([PQ-046](#)) and iPhone Display Adhesive Product Qualification ([PQ-053](#)) courses in ATLAS.

ACiT 2017 certification

Important: If you are not already ACiT 2017 certified, complete the ACiT 2018 exam instead.

With ACiT 2017 certification, you can service iPhone, iPad, Apple Watch and Apple TV devices after passing the following exams:

- Apple Service Fundamentals Exam (SVC-17A)
- ACiT 2017 iOS Service Certification Exam (iOS-17A)

Please note that the following devices have additional product qualification requirements:

- iPad Pro 12.9-inch (3rd generation), iPad Pro 12.9-inch (2nd Generation), iPad Pro 12.9-inch, iPad Pro 11.0-inch, iPad Pro 10.5-inch, iPad Pro 9.7-inch, iPad (6th Generation), iPad (5th Generation) and iPad mini 4
 - Also complete the Troubleshooting iPad course ([PQ-054](#)) in ATLAS.
- iPhone 8 and iPhone 8 Plus
 - Also complete the Servicing iPhone 8 and 8 Plus course ([PQ-036](#)) in ATLAS.
- iPhone X
 - Also complete the Servicing iPhone X course ([PQ-040](#)) in ATLAS
- iPhone XS and iPhone XS Max
 - Also complete the iPhone XS and iPhone XS Max Product Qualification ([PQ-045](#)) and iPhone Display Adhesive Product Qualification ([PQ-053](#)) courses in ATLAS.
- iPhone XR:
 - Also complete the iPhone XR Product Qualification ([PQ-046](#)) and iPhone Display Adhesive Product Qualification ([PQ-053](#)) courses in ATLAS.

ACiT 2016 certification

With ACiT 2016 certification, you can service iPhone, iPad, Apple Watch and Apple TV devices after passing these exams:

- Apple Service Fundamentals Exam (SVC-16A)
- ACiT 2016 iOS Service Certification Exam (iOS-16A)

Please note that the following devices have additional product qualification requirements:

- iPad Pro 12.9-inch (3rd generation), iPad Pro 12.9-inch (2nd Generation), iPad Pro 12.9-inch, iPad Pro 11.0-inch, iPad Pro 10.5-inch, iPad Pro 9.7-inch, iPad (6th Generation), iPad (5th Generation) and iPad mini 4
 - Also complete the Troubleshooting iPad course ([PQ-054](#)) in ATLAS.
- iPhone 7, iPhone 7 Plus
 - Also complete the Servicing iPhone 7 and iPhone 7 Plus course ([9L0-PQ20](#)) in ATLAS.
- iPhone 8 and iPhone 8 Plus
 - Also complete the Servicing iPhone 8 and 8 Plus course ([PQ-036](#)) in ATLAS.
- iPhone X
 - Also complete the Servicing iPhone X course ([PQ-040](#)) in ATLAS
- iPhone XS and iPhone XS Max
 - Also complete the iPhone XS and iPhone XS Max Product Qualification ([PQ-045](#)) and iPhone Display Adhesive Product Qualification ([PQ-053](#)) courses in ATLAS.
- iPhone XR:
 - Also complete the iPhone XR Product Qualification ([PQ-046](#)) and iPhone Display Adhesive Product Qualification ([PQ-053](#)) courses in ATLAS.

Exams and courses that you need to service Mac products

Training for Apple Certified Mac Technician (ACMT) 2018 is available to technicians who work at Apple-authorized service facilities. Technicians need a Global Service Exchange (GSX) account to view the courses in [ATLAS](#). To register for any ACMT exam, use [Pearson VUE](#).

ACMT 2018 certification

With ACMT 2018 certification, you can service Mac computers after passing these exams:

- Apple Service Fundamentals Exam (SVC-18A) or (SVC-17A)
- ACMT 2018 Mac Service Certification Exam (MAC-18A)

These computers have additional product qualification requirements:

- MacBook Pro (15-inch, 2018):
 - Also complete the MacBook Pro (15-inch, 2018) Product Qualification course ([PQ-044](#)) and System Configuration for Macs with the Apple T2 Security Chip course ([PQ-048](#)) in ATLAS.
- MacBook Pro (13-inch, 2018, Four Thunderbolt 3 Ports):
 - Also complete the MacBook Pro (13-inch, 2018, Four Thunderbolt 3 Ports) Product Qualification course ([PQ-043](#)) and System Configuration for Macs with the Apple T2 Security Chip course ([PQ-048](#)) in ATLAS.
- MacBook Air (Retina, 13-inch, 2018):
 - Also complete the MacBook Air (Retina, 13-inch, 2018) Product Qualification course ([PQ-051](#)) and System Configuration for Macs with the Apple T2 Security Chip course ([PQ-048](#)) in ATLAS.
- Mac mini (2018):
 - Also complete the Mac mini (2018) Product qualification course ([PQ-050](#)) and System Configuration for Macs with the Apple T2 Security Chip course ([PQ-048](#)) in ATLAS.

ACMT 2017 certification

Important: If you're not already ACMT 2017 certified, complete the ACMT 2018 exams instead.

With ACMT 2017 certification, you can service most Mac computers after passing these exams:

- Apple Service Fundamentals Exam (SVC-17A)
- ACMT 2017 Mac Service Certification Exam (MAC-17A)

These computers have additional product qualification requirements:

- MacBook Pro (15-inch, 2018):
 - Also complete the MacBook Pro (15-inch, 2018) Product Qualification course ([PQ-044](#)) and System Configuration for Macs with the Apple T2 Security Chip course ([PQ-048](#)) in

ATLAS.

- MacBook Pro (15-inch, 2016 and 2017):
 - Also complete the MacBook Pro with Four Thunderbolt 3 Ports ([9L0-PQ24](#)) and the Trackpad Calibration Check ([9L0-PQ15](#)) courses in ATLAS
- MacBook Pro (13-inch, 2018, Four Thunderbolt 3 Ports):
 - Also complete the MacBook Pro (13-inch, 2018, Four Thunderbolt 3 Ports) Product Qualification course ([PQ-043](#)) and System Configuration for Macs with the Apple T2 Security Chip course ([PQ-048](#)) in ATLAS.
- MacBook Pro (13-inch, 2016 and 2017, Four Thunderbolt 3 Ports):
 - Also complete the MacBook Pro with Four Thunderbolt 3 Ports ([9L0-PQ24](#)) and the Trackpad Calibration Check ([9L0-PQ15](#)) courses in ATLAS
- MacBook Pro (13-inch, 2016 and 2017, Two Thunderbolt 3 Ports):
 - Also complete the MacBook Pro with Two Thunderbolt 3 Ports ([9L0-PQ23](#)) and the Trackpad Calibration Check ([9L0-PQ15](#)) courses in ATLAS
- MacBook (Retina, 12-inch, 2017):
 - Also complete the MacBook (Retina, 12-inch, 2017) ([9L0-PQ32](#)), Trackpad Calibration Check ([9L0-PQ15](#)) and Interpreting Liquid Contact Indicators (LCIs) ([9L0-PQ30](#)) courses in ATLAS
- MacBook Air (Retina, 13-inch, 2018):
 - Also complete the MacBook Air (Retina, 13-inch, 2018) Product Qualification course ([PQ-051](#)) and System Configuration for Macs with the Apple T2 Security Chip course ([PQ-048](#)) in ATLAS.
- MacBook Air (11-inch, Mid 2013, Early 2014, and Early 2015) and MacBook Air (13-inch, Mid 2013, Early 2014, and 2017):
 - Also complete the MacBook Air course ([9L0-PQ31](#)) in ATLAS.
- iMac Pro (2017):
 - Also complete the Servicing iMac Pro (2017) ([PQ-041](#)) course in ATLAS
- iMac (2017):
 - Also complete the iMac (2017) ([9L0-PQ28](#)) course in ATLAS
- Mac mini (2018):
 - Also complete the Mac mini (2018) Product qualification course ([PQ-050](#)) and System Configuration for Macs with the Apple T2 Security Chip course ([PQ-048](#)) in ATLAS.

ACMT 2016 certification

If you're not already ACMT 2016 certified, complete the ACMT 2018 exams instead.

With ACMT 2016 certification, you can service most Mac computers (some have additional requirements) after passing these exams:

- Apple Service Fundamentals Exam (SVC-16A)
- ACMT 2016 Mac Service Certification Exam (MAC-16A)

These computers have additional requirements:

- MacBook Pro (15-inch, 2018):
 - Also complete the MacBook Pro (15-inch, 2018) Product Qualification course ([PQ-044](#)) and System Configuration for Macs with the Apple T2 Security Chip course ([PQ-048](#)) in ATLAS.
- MacBook Pro (15-inch, 2016 and 2017):
 - Also complete the MacBook Pro with Four Thunderbolt 3 Ports ([9L0-PQ24](#)) and the Trackpad Calibration Check ([9L0-PQ15](#)) courses in ATLAS
- MacBook Pro (13-inch, 2018, Four Thunderbolt 3 Ports):
 - Also complete the MacBook Pro (13-inch, 2018, Four Thunderbolt 3 Ports) Product Qualification course ([PQ-043](#)) and System Configuration for Macs with the Apple T2 Security Chip course ([PQ-048](#)) in ATLAS.
- MacBook Pro (13-inch, 2016 and 2017, Four Thunderbolt 3 Ports):
 - Also complete the MacBook Pro with Four Thunderbolt 3 Ports ([9L0-PQ24](#)) and the Trackpad Calibration Check ([9L0-PQ15](#)) courses in ATLAS
- MacBook Pro (13-inch, 2016 and 2017, Two Thunderbolt 3 Ports):
 - Also complete the MacBook Pro with Two Thunderbolt 3 Ports ([9L0-PQ23](#)) and the Trackpad Calibration Check ([9L0-PQ15](#)) courses in ATLAS
- MacBook (Retina, 12-inch, 2017):
 - Also complete the MacBook (Retina, 12-inch, 2017) ([9L0-PQ32](#)), Trackpad Calibration Check ([9L0-PQ15](#)) and Interpreting Liquid Contact Indicators (LCIs) ([9L0-PQ30](#)) courses in ATLAS
- MacBook (Retina, 12-inch, Early 2016):
 - Also complete the MacBook (Retina, 12-inch, Early 2016) ([9L0-PQ18](#)) and the Trackpad Calibration Check ([9L0-PQ15](#)) courses in ATLAS.
- MacBook Air (Retina, 13-inch, 2018):

- Also complete the MacBook Air (Retina, 13-inch, 2018) Product Qualification course ([PQ-051](#)) and System Configuration for Macs with the Apple T2 Security Chip course ([PQ-048](#)) in ATLAS.
- MacBook Air (11-inch, Mid 2013, Early 2014, and Early 2015) and MacBook Air (13-inch, Mid 2013, Early 2014, and 2017):
 - Also complete the MacBook Air course ([9L0-PQ31](#)) in ATLAS.
- iMac Pro (2017):
 - Also complete the Servicing iMac Pro (2017) ([PQ-041](#)) course in ATLAS
- iMac (2017):
 - Also complete the iMac (2017) ([9L0-PQ28](#)) course in ATLAS
- iMac (2015):
 - Also complete the iMac (Late 2015) ([9L0-PQ17](#)) course in ATLAS.
- Mac mini (2018):
 - Also complete the Mac mini (2018) Product qualification course ([PQ-050](#)) and System Configuration for Macs with the Apple T2 Security Chip course ([PQ-048](#)) in ATLAS.

ACMT 2015 certification

If you're not already ACMT 2015 certified, complete the ACMT 2018 exams and courses instead.

With ACMT 2015 certification, you can service many Mac computers (some have additional requirements) if you passed these exams:

- OS X Yosemite Troubleshooting Exam (9L0-066)
- Mac Hardware Service Exam (9L0-012)

These computers have additional requirements:

- MacBook Pro (15-inch, 2018):
 - Also complete the MacBook Pro (15-inch, 2018) Product Qualification course ([PQ-044](#)) and System Configuration for Macs with the Apple T2 Security Chip course ([PQ-048](#)) in ATLAS.
- MacBook Pro (15-inch, 2016 and 2017):
 - Also complete the MacBook Pro with Four Thunderbolt 3 Ports ([9L0-PQ24](#)) and the Trackpad Calibration Check ([9L0-PQ15](#)) courses in ATLAS
- MacBook Pro (Retina, 15-inch, Mid 2015):
 - Also complete the MacBook Pro 15-inch (2012 to 2015) ([9L0-PQ34](#)) and the Trackpad Calibration Check ([9L0-PQ15](#)) courses in ATLAS
- MacBook Pro (13-inch, 2018, Four Thunderbolt 3 Ports):
 - Also complete the MacBook Pro (13-inch, 2018, Four Thunderbolt 3 Ports) Product Qualification course ([PQ-043](#)) and System Configuration for Macs with the Apple T2 Security Chip course ([PQ-048](#)) in ATLAS.
- MacBook Pro (13-inch, 2016 and 2017, Four Thunderbolt 3 Ports):
 - Also complete the MacBook Pro with Four Thunderbolt 3 Ports ([9L0-PQ24](#)) and the Trackpad Calibration Check ([9L0-PQ15](#)) courses in ATLAS
- MacBook Pro (13-inch, 2016 and 2017, Two Thunderbolt 3 Ports):
 - Also complete the MacBook Pro with Two Thunderbolt 3 Ports ([9L0-PQ23](#)) and the Trackpad Calibration Check ([9L0-PQ15](#)) courses in ATLAS
- MacBook Pro (Retina, 13-inch, Early 2015):
 - Also complete the MacBook Pro 13-inch (2012 to 2015) course ([9L0-PQ33](#)) in ATLAS.
- MacBook (Retina, 12-inch, 2017):
 - Also complete the MacBook (Retina, 12-inch, 2017) ([9L0-PQ32](#)), Trackpad Calibration Check ([9L0-PQ15](#)) and Interpreting Liquid Contact Indicators (LCIs) ([9L0-PQ30](#)) courses in ATLAS
- MacBook (Retina, 12-inch, Early 2016):
 - Also complete the MacBook (Retina, 12-inch, Early 2016) ([9L0-PQ18](#)) and the Trackpad Calibration Check ([9L0-PQ15](#)) courses in ATLAS.
- MacBook (Retina, 12-inch, Early 2015):
 - Also complete the MacBook (Retina, 12-inch, Early 2015) ([9L0-PQ14](#)) and the Trackpad Calibration Check ([9L0-PQ15](#)) courses in ATLAS.
- MacBook Air (Retina, 13-inch, 2018):
 - Also complete the MacBook Air (Retina, 13-inch, 2018) Product Qualification course ([PQ-051](#)) and System Configuration for Macs with the Apple T2 Security Chip course ([PQ-048](#)) in ATLAS.
- MacBook Air (11-inch, Mid 2013, Early 2014, and Early 2015) and MacBook Air (13-inch, Mid 2013, Early 2014, and 2017):
 - Also complete the MacBook Air course ([9L0-PQ31](#)) in ATLAS.
- iMac Pro (2017):
 - Also complete the Servicing iMac Pro (2017) ([PQ-041](#)) course in ATLAS
- iMac (2017):

- Also complete the iMac (2017) ([9L0-PQ28](#)) course in ATLAS
- iMac (2015):
 - Also complete the iMac (Late 2015) ([9L0-PQ17](#)) course in ATLAS.
- Mac mini (2018):
 - Also complete the Mac mini (2018) Product qualification course ([PQ-050](#)) and System Configuration for Macs with the Apple T2 Security Chip course ([PQ-048](#)) in ATLAS.

ACMT certification

If you're not already ACMT certified, complete the ACMT 2018 exams and courses instead.

With ACMT certification, you can service certain Mac computers (some have additional requirements) after passing these exams:

- Mac OS X Mavericks Troubleshooting Exam (9L0-065)
- Mac Hardware Service Exam (9L0-011)

These computers have additional requirements. (Some of these exams and courses are not currently available.)

- MacBook Pro (15-inch, 2018):
 - Also complete the MacBook Pro (15-inch, 2018) Product Qualification course ([PQ-044](#)) and System Configuration for Macs with the Apple T2 Security Chip course ([PQ-048](#)) in ATLAS.
- MacBook Pro (15-inch, 2016 and 2017):
 - Also complete the MacBook Pro with Four Thunderbolt 3 Ports ([9L0-PQ24](#)) and the Trackpad Calibration Check ([9L0-PQ15](#)) courses in ATLAS
- MacBook Pro (Retina, Mid 2012) and MacBook Pro (Retina, 15-inch, Early 2013 to Mid 2014):
 - Also complete the MacBook Pro 15-inch (2012 to 2015) ([9L0-PQ34](#)) and the Trackpad Calibration Check ([9L0-PQ15](#)) courses in ATLAS
- MacBook Pro (13-inch, 2018, Four Thunderbolt 3 Ports):
 - Also complete the MacBook Pro (13-inch, 2018, Four Thunderbolt 3 Ports) Product Qualification course ([PQ-043](#)) and System Configuration for Macs with the Apple T2 Security Chip course ([PQ-048](#)) in ATLAS.
- MacBook Pro (13-inch, 2016 and 2017):
 - Also complete the MacBook Pro with Four Thunderbolt 3 Ports ([9L0-PQ24](#)) and the Trackpad Calibration Check ([9L0-PQ15](#)) courses in ATLAS
- MacBook Pro (13-inch, 2016 and 2017, Two Thunderbolt 3 Ports):
 - Also complete the MacBook Pro with Two Thunderbolt 3 Ports ([9L0-PQ23](#)) and the Trackpad Calibration Check ([9L0-PQ15](#)) courses in ATLAS
- MacBook Pro (Retina, 13-inch, Late 2012 to Early 2015):
 - Also complete the MacBook Pro 13-inch (2012 to 2015) course ([9L0-PQ33](#)) in ATLAS.
- MacBook (Retina, 12-inch, 2017):
 - Also complete the MacBook (Retina, 12-inch, 2017) ([9L0-PQ32](#)), Trackpad Calibration Check ([9L0-PQ15](#)) and Interpreting Liquid Contact Indicators (LCIs) ([9L0-PQ30](#)) courses in ATLAS
- MacBook (Retina, 12-inch, Early 2016):
 - Also complete the MacBook (Retina, 12-inch, Early 2016) ([9L0-PQ18](#)) and the Trackpad Calibration Check ([9L0-PQ15](#)) courses in ATLAS.
- MacBook (Retina, 12-inch, Early 2015):
 - Also complete the MacBook (Retina, 12-inch, Early 2015) ([9L0-PQ14](#)) and the Trackpad Calibration Check ([9L0-PQ15](#)) courses in ATLAS.
- MacBook Air (Retina, 13-inch, 2018):
 - Also complete the MacBook Air (Retina, 13-inch, 2018) Product Qualification course ([PQ-051](#)) and System Configuration for Macs with the Apple T2 Security Chip course ([PQ-048](#)) in ATLAS.
- MacBook Air (11-inch, Mid 2013, Early 2014, and Early 2015) and MacBook Air (13-inch, Mid 2013, Early 2014, and 2017):
 - Also complete the MacBook Air course ([9L0-PQ31](#)) in ATLAS.
- iMac Pro (2017):
 - Also complete the Servicing iMac Pro (2017) ([PQ-041](#)) course in ATLAS
- iMac (2017):
 - Also complete the iMac (2017) ([9L0-PQ28](#)) course in ATLAS
- iMac (2015):
 - Also complete the iMac (Late 2015) ([9L0-PQ17](#)) course in ATLAS.
- iMac (Late 2012 to Mid 2015 models):
 - Also complete the iMac (2012 to 2015) course ([9L0-PQ3](#)) in ATLAS.
- Mac mini (2018):
 - Also complete the Mac mini (2018) Product Qualification course ([PQ-050](#)) and System Configuration for Macs with the Apple T2 Security Chip course ([PQ-048](#)) in ATLAS.

About the Apple Service Fundamentals Exam (SVC-18A)

The Apple Service Fundamentals Exam (SVC-18A) is a computer-based knowledge test that Pearson VUE offers online. The test is open resource and test takers should use Apple references and courses in ATLAS to help answer the exam items.

Successful completion of this exam fulfills the prerequisite for Apple Certified iOS Technician (ACiT) 2018 certification and Apple Certified Mac Technician (ACMT) 2018 certification. The SVC-18A exam must be successfully completed before taking the Mac or iOS certification exams.

Exam summary

- Number of sections: 5
- Number of learning objectives: 34
- Number of total items: 70
- Passing score: 80 percent overall (at least 56 out of 70 items to pass)
- Exam time limit: 2 hours

Seven demographic questions are presented at the beginning of the exam. These items aren't scored and don't use the 2 hours given for the exam.

Two separately scored sections must be passed

The exam has two separately-scored sections that each must be passed to pass the entire exam. This is in addition to the overall passing score listed above. The two sections are listed below:

- The ESD Precautions section (at least 10 out of 12 questions answered correctly to pass)
- The Safety section (at least 10 out of 12 questions answered correctly to pass)

Sections and topics

Here are the sections and topics covered in Apple Service Fundamentals Exam:

Customer Experience (23 items)

- Identify the probing skills that result in getting good information from the customer
- Select good examples of reflecting and summarizing the customer's answers in order to come to agreement on the issue
- Identify ways to properly position a repair so that the customer knows why it is necessary and is in agreement with the strategy
- Identify ways to position and recommend upgrades and attachments as part of an alternative service strategy.
- Demonstrate use of the "Positive No" in a series of choose-the-phrase exercises
- List practical applications of the four cornerstones of adult learning
- Describe the effect of both complex technical language and over-simplified language
- Identify good examples of phrases to help set accurate customer expectations
- Describe the role of empathy in customer satisfaction
- Identify ways to avoid conflict by using genuine empathy
- Identify causes for conflict in an interaction
- Identify the five-step anger diffusion technique given a customer scenario
- Assess and explain the impact of non-verbal communication

ESD Precautions (12 items)

- Correctly identify and practice ESD precautions
- Correctly identify the components of an ESD-compliant workstation
- Use the proper tools, equipment, and procedures to configure a workspace that minimizes or eliminates the occurrence of electrostatic discharge damage
- Correctly identify the effects of ESD damage on an integrated circuit
- Correctly identify common ESD myths and why they are not true

Safety (12 items)

- Identify those customer statements that will generate a Safety First issue
- Explain the importance of exercising special care when handling lithium-ion/polymer batteries
- Demonstrate the proper and safe handling of batteries
- Recognize and identify signs and symptoms of damaged batteries
- Respond to events involving embedded batteries

Troubleshooting (8 items)

- Identify the different stages of troubleshooting and service where diagnostic tools are useful
- List the components of clear, concise and complete case notes
- Demonstrate basic troubleshooting and deductive reasoning skills
- Use smart questioning techniques and first-level evaluation and isolation skills to identify issues as being generally hardware based, software based, educational, or environmental in nature

Product Knowledge (15 items)

- List and understand basic iOS controls and navigation
- Identify the components of the default macOS user environment
- List Apple Watch controls and Navigation
- Given a customer scenario, evaluate, isolate, and resolve an Apple ID related issue
- List the steps to configure Continuity services in macOS and in iOS
- Describe how to configure a Bluetooth device in an Apple product
- Identify the methods for backing up and restoring data on an Apple product

Courses in ATLAS

To prepare for the Apple Service Fundamentals Exam, we suggest that you review the courses in the 2018 Service Fundamentals subject area in ATLAS. The list of courses in the suggested order can be found in [2018 Service Fundamentals](#).

About the ACiT 2018 iOS Service Certification Exam (iOS-18A)

The ACiT 2018 iOS Service Certification Exam is a computer-based knowledge test that Pearson VUE offers online. This is an open-resource test. We encourage you to use Apple references and courses in ATLAS to answer the questions.

To earn Apple Certified iOS Technician (ACiT) 2018 certification, you need to pass this exam (iOS-18A) and the Apple Service Fundamentals Exam (SVC-18A).

Please note: The Apple Service Fundamentals Exam must be taken before you take the iOS Service Certification Exam.

Exam summary

- Number of sections: 2
- Number of learning objectives: 18
- Number of total items: 70
- Passing score: 80 percent overall (at least 56 out of 70 items to pass)
- Exam time limit: 2 hours

Seven demographic questions are presented at the beginning of the exam. These items aren't scored and don't use the 2 hours given for the exam.

Sections and topics

Here are the sections and topics covered in ACiT Exam:

Troubleshooting (38 items)

- Describe the diagnostics used in troubleshooting a given scenario
- Given an isolated issue, categorize the issue as either hardware (including accidental damage), software, environmental, or educational opportunity
- Order the steps in the iOS setup and activation process
- List common resolutions for battery-related issues
- Identify basic controls for mailbox management
- Describe the built-in apps and features of iOS
- Describe how to personalize and customize iPhone General and Accessibility settings
- Describe the privacy settings that can be put in place for apps

Servicing iPhone (32 items)

- Identify the physical supplies and online resources necessary to ensure proper and safe servicing of an iPhone model
- Given a simulated workstation, identify the supplies that are necessary to reduce the possibility of being harmed while servicing iPhone
- Identify the tools that are commonly used to service all iOS models
- Identify the correct specialized tools, fixtures, and procedures required to service iPhone 5s
- Identify the correct specialized tools, fixtures, and procedures required to service iPhone 5c

- Identify the correct specialized tools, fixtures, and procedures required to service iPhone 6 and iPhone 6 Plus
- Identify the correct specialized tools, fixtures, and procedures required to service iPhone 6s and iPhone 6s Plus
- Identify the correct specialized tools, fixtures, and procedures required to service iPhone SE
- Identify the correct specialized tools, fixtures, and procedures required to service iPhone 7 and iPhone 7 Plus
- Identify the correct specialized tools, fixtures, and procedures required to service iPhone 8 and 8 Plus
- Identify the correct specialized tools, fixtures, and procedures required to service iPhone X

Courses in ATLAS

To prepare for the ACiT 2018 iOS Service Certification Exam (iOS-18A), we suggest that you review the courses in the ACiT 2018 subject area in ATLAS. The list of courses in the suggested order can be found in [ACiT 2018 Overview](#).

About the ACMT 2018 Mac Service Certification Exam (MAC-18A)

The ACMT 2018 Mac Service Certification Exam (MAC-18A) is a computer-based knowledge test that Pearson VUE offers online. This is an open-resource test. We encourage you to use Apple references and courses in ATLAS to answer the questions.

To earn Apple Certified Mac Technician (ACMT) 2018 certification, you need to pass this exam (MAC-18A) and the Apple Service Fundamentals Exam (SVC-18A).

Please note: You must complete the Apple Service Fundamentals Exam before you take the Mac Service Certification Exam.

Exam summary

- Number of sections: 2
- Number of learning objectives: 28
- Number of total items: 70
- Passing score: 80 percent overall (at least 56 out of 70 items to pass)
- Exam time limit: 2 hours

Seven demographic questions are presented at the beginning of the exam. These items aren't scored and don't use the 2 hours given for the exam.

Sections and topics

Here are the sections and topics covered in ACMT Exam:

Troubleshooting (36 items)

- Evaluate and isolate file system issues with macOS-based systems
- Given a network related customer issue, accurately evaluate, isolate and resolve the issue
- Correctly identify the diagnostic tool most appropriate to a given troubleshooting scenario
- Describe how to use troubleshooting tools and related procedures
- Identify potential startup issues and associated fixes
- Identify macOS migration tools needed for migration, the types of user data that can be migrated, and the correct methods for migrating user data from both a Mac and PC
- Identify the symptoms that are a result of an SMC that is not functioning correctly
- Explain how to maximize the battery life of an Apple product
- Identify the process to create, configure, manage, and delete user accounts in macOS
- Configure FileVault 2 in macOS to secure the data on a Mac
- Describe the data privacy concerns that are presented when Location Services is enabled in macOS
- Describe the method for resetting a lost Firmware (EFI) password
- Describe how to use Time Machine in macOS to create, restore, and manage a secure data backup

Repairing the Mac Family (34 items)

- Given a simulated workstation, identify the supplies that are necessary to reduce the possibility of damaging the customer's Mac while servicing the computer
- Given a simulated workstation, identify the supplies that are necessary to reduce the possibility of being harmed while servicing Mac models
- Demonstrate the proper and safe handling of batteries and portable computer case assemblies with built-in battery

- Identify specialized tools, fixtures or procedures required to service iMac
- Identify safety precautions necessary to safely service iMac models
- Identify specialized tools, fixtures or procedures required to service iMac Pro
- Identify safety precautions necessary to safely service iMac Pro models
- Identify specialized tools, fixtures or procedures required to service Mac mini
- Identify specialized tools, fixtures or procedures required to service MacBook Pro 13-inch models
- Identify internal connector types for specific MacBook Pro 13-inch models
- Identify specialized tools, fixtures or procedures required to service MacBook Pro 15-inch models
- Identify internal connector types for specific MacBook Pro 15-inch models
- Identify specialized tools, fixtures or procedures required to service MacBook Air
- Identify specialized tools, fixtures or procedures required to service Mac Pro
- Identify internal connector types for specific Mac Pro models
- Identify safety precautions necessary to safely service Mac Pro models
- Identify specialized tools, fixtures or procedures required to service MacBook

Courses in ATLAS

To prepare for the ACMT 2018 Mac Service Certification Exam (MAC-18A), we suggest that you review the courses in the ACMT 2018 subject area in ATLAS. The list of courses in the suggested order can be found in [ACMT 2018 Overview](#).

Frequently Asked Questions

Can anyone take the service certification exams?

Yes. Anyone can take the exams to become an Apple Certified Mac Technician (ACMT) 2018 or Apple Certified iOS Technician (ACiT) 2018. To pass these exams, you need to have access to the training in [ATLAS](#).

Successfully completing the exams doesn't mean that Apple has authorized you to perform repairs or to conduct business directly with Apple or on Apple's behalf. Apple certifies (verifies the skills of) technicians. Apple authorizes (establishes business relationships with) service providers. These two things aren't the same.

How do I register for the exams?

Go to certifications.apple.com to register and create a Tech ID. Then use your [Tech ID](#) to register at an Apple Authorized Training Center or online with Pearson VUE. After you've taken an Apple certification exam, you can track and manage all of your Apple certifications at the certifications website.

How do I prepare for the service certification exams?

Apple provides self-paced training courses in ATLAS through Global Service Exchange (GSX). Apple Authorized Service Providers (AASPs) and Self-Servicing Accounts (SSAs) can get the Service Training curriculum online for free.

The Apple Service Fundamentals Exam (SVC-18A) has sections on ESD precautions and technician safety. You must pass these sections in order to pass the exam as a whole.

If I don't pass an exam, how soon can I retake it?

You can retake an exam 24 hours after completing the last attempt.

How do I pay for the exams?

When you register for the certification exams, you can pay with Visa, MasterCard, or American Express.

Where can I verify my exams or certification status?

To verify your exam and certification status, go to certifications.apple.com. In the "Certification" tab, look for the corresponding Certification Name in "My Certifications" and verify that the status is "Certified". To view exam details, click the relevant Certification Name.

I checked my certification status at certifications.apple.com and it is "In Progress". What does that mean?

If your certifications status is "In Progress", it signifies that not all requirements for the certification were completed. To achieve "Certified" status, some certifications require one or more additional courses or exams to be completed.

I have certifications on two different TechIDs. What should I do?

Your TechIDs will need to be manually updated. Send an email to certifications@apple.com with your exam results and TechID information.

I passed my exam, but when I checked my certification it is not on certifications.apple.com. Why is my certification missing?

Your certifications may take up to 72 hours to appear on certifications.apple.com after you pass the exam. If it has been longer, please send an email to certifications@apple.com.

I have other questions. Where can I get them answered?

You can send your questions to svc.trng@apple.com.

Questions about Apple Certified iOS Technician (ACiT) 2018

What is ACiT 2018?

It's a program to become Apple-certified as an iOS technician.

How is ACiT 2018 different from previous ACiT 2017 certification?

ACiT 2018 qualifies a technician to repair iOS products that were produced before April 2018. This includes:

- iPhone 8 and iPhone 8 Plus
- iPhone X
- iPad (6th generation)

What exams are required for ACiT 2018?

To get ACiT 2018 certification, you need to pass the Apple Service Fundamentals Exam (SVC-18A) or (SVC-17A) and the ACiT 2018 iOS Service Certification Exam (iOS-18A). These exams are available from Pearson VUE. You can take the exams online from your own computer.

Does it matter in what order I take the exams?

Yes. Before you can register for the ACiT 2018 iOS Service Certification Exam (iOS-18A), you must pass the Apple Service Fundamentals Exam.

How much does each exam cost?

The cost of the exam is \$20 USD (2,215 yen for Japan). Current pricing is available from Apple Authorized Training Centers or [Pearson VUE](https://www.pearsonvue.com).

Where do I find the training for these exams?

Training for these exams is available in [ATLAS](https://atlas.apple.com). Access ACiT 2018 courses at Apple-authorized service facilities.

I'm already ACiT 2017 certified. Do I need to take the new ACiT 2018 exams?

No. If you're certified for the iOS products you need to repair, no new exams are required.

Will separate iOS qualification exams be required for new iOS products?

No. Apple will introduce new qualification courses in ATLAS as products are introduced. You have to complete these courses to service these new products.

I've completed the SVC-17A exam. How long will the iOS-17A exam be available? Do I need to take two new exams for ACiT certification?

If you've completed the SVC-17A for ACiT 2017, the ACiT exam will be available until July 27, 2018. Until then, completion of SVC-17A and iOS-17A exams will still grant you ACiT 2017 certification, but it won't cover as many products. To get ACiT 2018 certification, the SVC-18A and iOS-18A exams are required.

What will I have to do to service new iOS products that are introduced after I'm certified?

Apple will introduce new qualification courses in ATLAS as products are introduced. You have to complete these courses to service these new products.

I have completed the Apple Certified Mac Technician (ACMT) 2018 certification. Do I need to take two new exams for ACiT certification?

No. If you're ACMT 2018 certified, you've passed the Apple Service Fundamentals Exam. You only need to pass the ACiT 2018 iOS Service Certification Exam (iOS-18A) to be ACiT 2018 certified.

When I complete the requirements for ACiT 2018, will I get a printed certificate?

Yes. After you pass the required exams, send an email to certifications@apple.com and ask for a certificate. You'll get an email with a link to the request form.

I have other questions. Where can I get them answered?

You can send your questions to svc.trng@apple.com.

Questions about Apple Certified Mac Technician (ACMT) 2018

What is ACMT 2018?

Apple Mac Technician (ACMT) 2018 is a new version of the Apple Certified Mac Technician certification.

How is ACMT 2018 different from previous ACMT certifications?

ACMT 2018 qualifies a technician to repair all the Mac products that were covered by prior ACMT certifications, plus all other Mac products that were produced before April 2018. This includes MacBook and MacBook Pro products that required a separate qualification exam or course in ATLAS:

- MacBook (Retina, 12-inch, 2017)
- MacBook Air (2017)
- MacBook Pro (13-inch, 2017, Four Thunderbolt 3 Ports)
- MacBook Pro (13-inch, 2017, Two Thunderbolt 3 Ports)
- MacBook Pro (15-inch, 2017)
- iMac Pro (2017)
- iMac (2017)

ACMT 2018 allows a technician who works at an Apple-authorized service facility to service all of these products.

What exams are required for ACMT 2018?

To get ACMT 2018 certification, you need to pass the Apple Service Fundamentals Exam (SVC-18A) or (SVC-17A) and ACMT 2018 Mac Service Certification Exam (MAC-18A). These exams are available from Pearson VUE. You can take the exams online from your own computer.

Does it matter in what order I take the exams?

Yes. Before you can register for the ACMT 2018 Mac Service Certification Exam (MAC-18A), you must pass the Apple Service Fundamentals Exam.

How much do each of the exams cost?

The cost of the exam is \$20 USD (2,215 yen for Japan). Current pricing is available from Apple Authorized Training Centers or [Pearson VUE](#).

Where do I find the training for these exams?

Training for these exams is available in [ATLAS](#). You can access ACMT 2018 courses at Apple authorized service facilities.

I'm already ACMT 2017 certified. Do I need to take the new ACMT 2018 exams?

No. If you're certified for the Mac products you need to repair, no new exams are required.

I've completed the Apple Certified iOS Technician (ACiT 2018) certification. Do I need to take two new exams for ACMT certification?

No. If you're ACiT 2018 certified, you've already passed the Apple Service Fundamentals Exam. You only need to take and pass the ACMT 2018 Mac Service Certification Exam (MAC-18A) to be ACMT 2018 certified.

Will separate Mac qualification exams still be available?

Apple will publish new qualification courses in ATLAS for new Apple products as needed. If you're already ACMT certified and want to repair a product with separate course requirements, you'll be able to do so.

I've completed one of the previous ACMT 2017 exams. Do I need to take two new exams for ACMT certification?

If you've completed the SVC-17A exam for ACMT, the remaining ACMT exam will be available until July 27, 2018. Until then, completion of SVC-17A and MAC-17A exams will still grant you ACMT 2017 certification, but it won't cover as many products. To get ACMT 2018 certification, the SVC-18A / SVC-17A and MAC-18A exams are required.

What will I have to do to service new Mac products that are introduced after I'm certified?

Apple will introduce new qualification courses in ATLAS as products are introduced. You have to complete these courses to service the new products.

When I complete the requirements for ACMT 2018, will I get a printed certificate?

Yes. After you pass the required exams, send an email to certifications@apple.com and ask for a certificate. You'll get an email with a link to the request form.

I have other questions. Where can I get them answered?

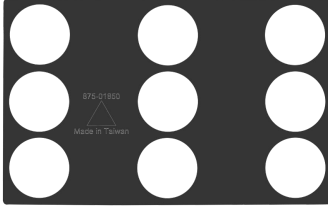
You can send your questions to svc.trng@apple.com.

Trackpad Calibration Check

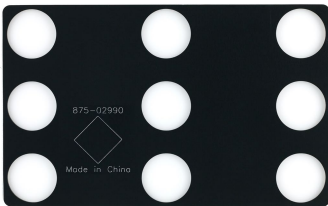
For video instruction, refer to [SV279: Force Touch Trackpad Calibration Check Video](#).

Required tools:

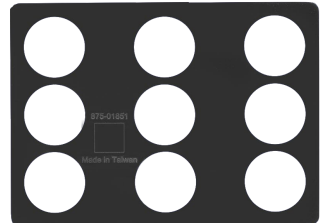
- Weight Placement Rubber Template (923-00555)
 - MacBook (Retina, 12-inch, Early 2015, Early 2016, and 2017)



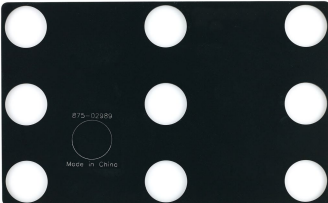
- Weight Placement Rubber Template (923-01316)
 - MacBook Pro (13-inch, 2016 and 2017, Two Thunderbolt 3 Ports)
 - MacBook Pro (13-inch, 2016, 2017, and 2018, Four Thunderbolt 3 Ports)



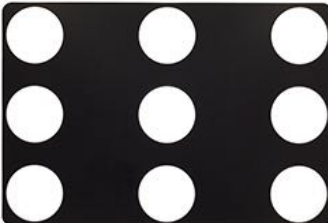
- Weight Placement Rubber Template (923-00599)
 - MacBook Pro (Retina, 13-inch, Early 2015) and (Retina, 15-inch, Mid 2015)



- Weight Placement Rubber Template (923-01317)
 - MacBook Pro (15-inch, 2016, 2017, and 2018)



- Weight Placement Rubber Template (923-02462)
 - MacBook Air (Retina, 13-inch, 2018)



Note: Weight Placement Rubber Templates come in a pack of three. If the edges start to curl, it is necessary to order a new pack.

- 200g and 800g weights (923-00462)

**Steps:**

To verify that the trackpad is responding as expected, run the Trackpad Calibration Check after every repair, including when only the bottom case has been removed and reassembled.

Note: It is recommended to also run the Trackpad Response test after a top case with keyboard has been replaced, or if the user is having issues related to trackpad functionality.

1. Place the Weight Placement Rubber Template on the trackpad before launching the test in AST 2. This establishes the correct baseline for the weights.

Important: Do not tape the Weight Placement Rubber Template to the top case. Tape may cause inaccurate test results.



2. Launch AST 2. In Diagnostic Console, select Trackpad Calibration Check from the list of diagnostic suites. For more information on AST 2, refer to [TP1279: AST 2: Supported Products and Tests](#).

Caution: The Trackpad Calibration Check is very sensitive to external disturbances. Run the test on a flat surface. Do not

run the diagnostic on a bench where other technicians are working. To avoid interfering with the results, be sure to place weights down gently on a separate surface while running the diagnostic. If the computer is bumped or jostled while the diagnostic is running, restart the test.

Diagnostic Console

John Doe |

< Diagnostic Results

Diagnostic Suites

TRIAGE

Trackpad Response

Assists in verifying functionality of trackpad.

3 minutes

>

REPAIR

Trackpad Calibration Check

Verifies calibration of the trackpad actuator and force sensor.

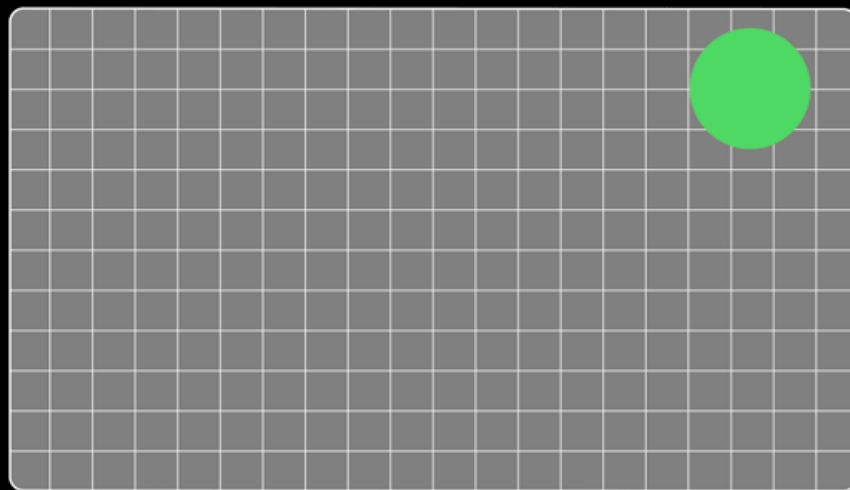
3 minutes

>

3. The diagnostic suite consists of several stages. The first stage of the suite is the Force Check, which is interactive and requires placing the 200g and 800g weights as indicated. The blue dot will indicate where on the trackpad to place each weight. The text at the bottom of the screen will indicate which weight to use at each step. The dot will turn green when it is time to lift the weight from the trackpad.

Test Instruction

Place the 200g weight on the indicated area and press any key.



Test Instruction

Remove the weight from the indicated area and press any key.

4. The next stage is the Actuator Check. During this stage, the trackpad will make clicking sounds while the actuator is tested. If any issues with the actuator are identified, the test may need to proceed to the next stage, which is the Actuator Calibration. The trackpad will continue to make clicking sounds while the actuator is calibrated. During this process, the unit under test (UUT) will display the screen shown below.

Checking your Mac...

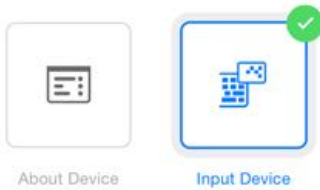


Restart



Shut Down

5. If no issues are found, the screen will look like the image below. The trackpad calibration is verified.



- ✓ Actuator Calibration
- ✓ Critical Error Test
- ✓ Open Test
- ✓ Force Check

6. If issues were found in the Actuator Check, the Actuator Calibration, or the Force Check, the screen will look like the image below and the suite should be run again. If the computer fails a second time, a top case with keyboard replacement is recommended.



- ✓ Actuator Calibration
- ✓ Critical Error Test
- ✓ Open Test
- ! Force Check

Connector Types on the Logic Board

Connector Types on the Logic Board for MacBook Air (Retina, 13-inch, 2018)

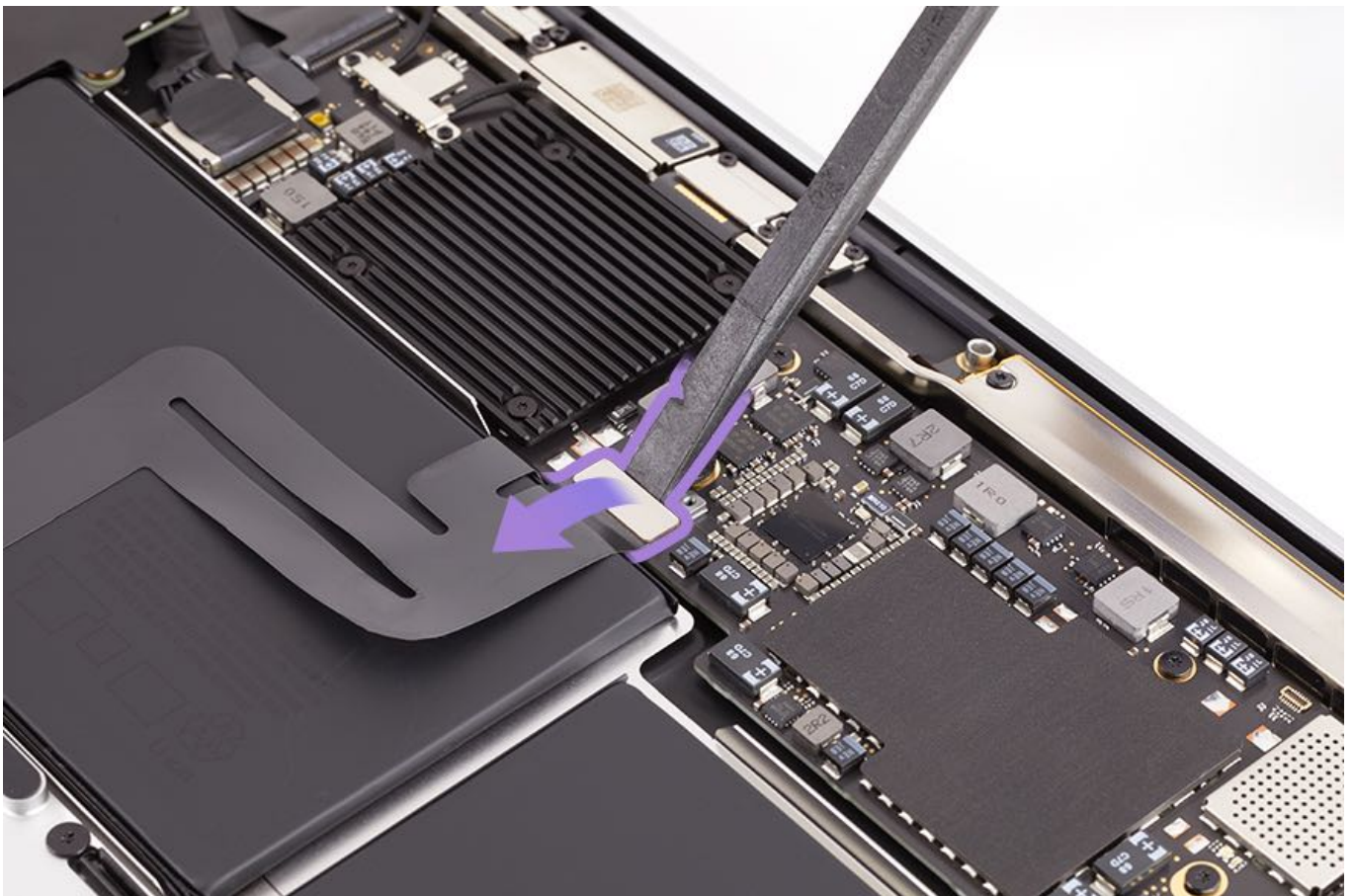
This article discusses how to disconnect and connect the various types of connectors in this model of computer and provides examples of each connector type.

Caution: Do not disconnect or reconnect cables while the computer has power.

Low-Profile Solid Platform Flex

- Remove and insert the cable vertically. The pins on the connectors can be bent if they are not inserted carefully and correctly.
- To reconnect the cable, keep the connector level to the board and press down evenly.
- Examples:
 - Input device (IPD) flex cable to logic board
 - I/O board cable

For video instruction, refer to [SV89: Solid Platform Flex Connectors Video](#).



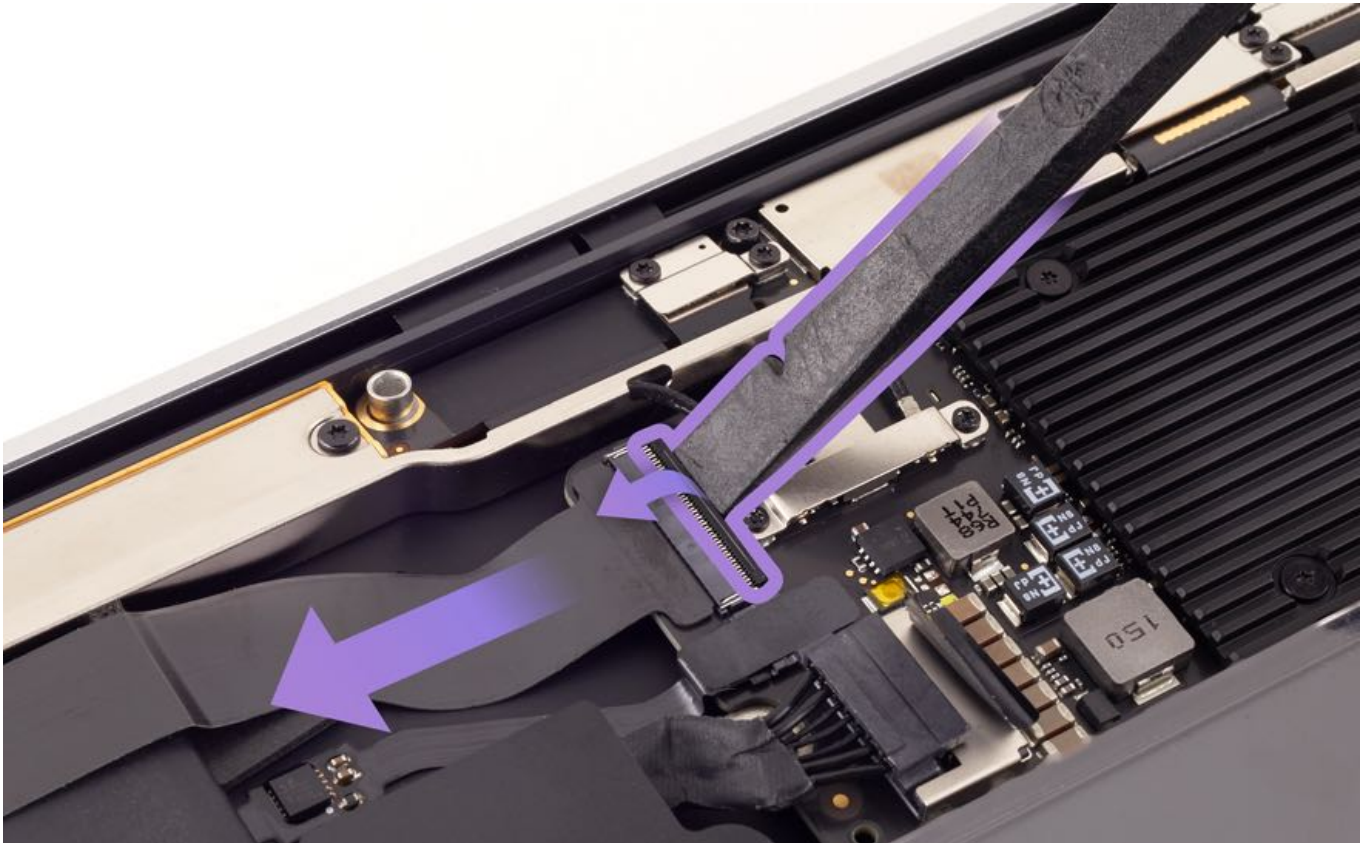
Locking Lever

Example:

- Flip the lever up to a 90-degree angle for cable removal.
- Slide the cable into the receptacle on the same horizontal plane as the logic board.
- Lock down the lever after inserting the cable.
- Open the lever when handling or shipping a logic board module, whether it is a known-good or a known-bad board.
 - Audio flex cable to logic board
 - Fan
 - IPD flex cable to top case



Caution: The locking levers on the logic board are fragile. To protect the levers during handling or shipment of the logic board, always leave the levers open after the cables are removed. Once the logic board is installed in the top case and the cables are connected, be sure to lock down the levers again.

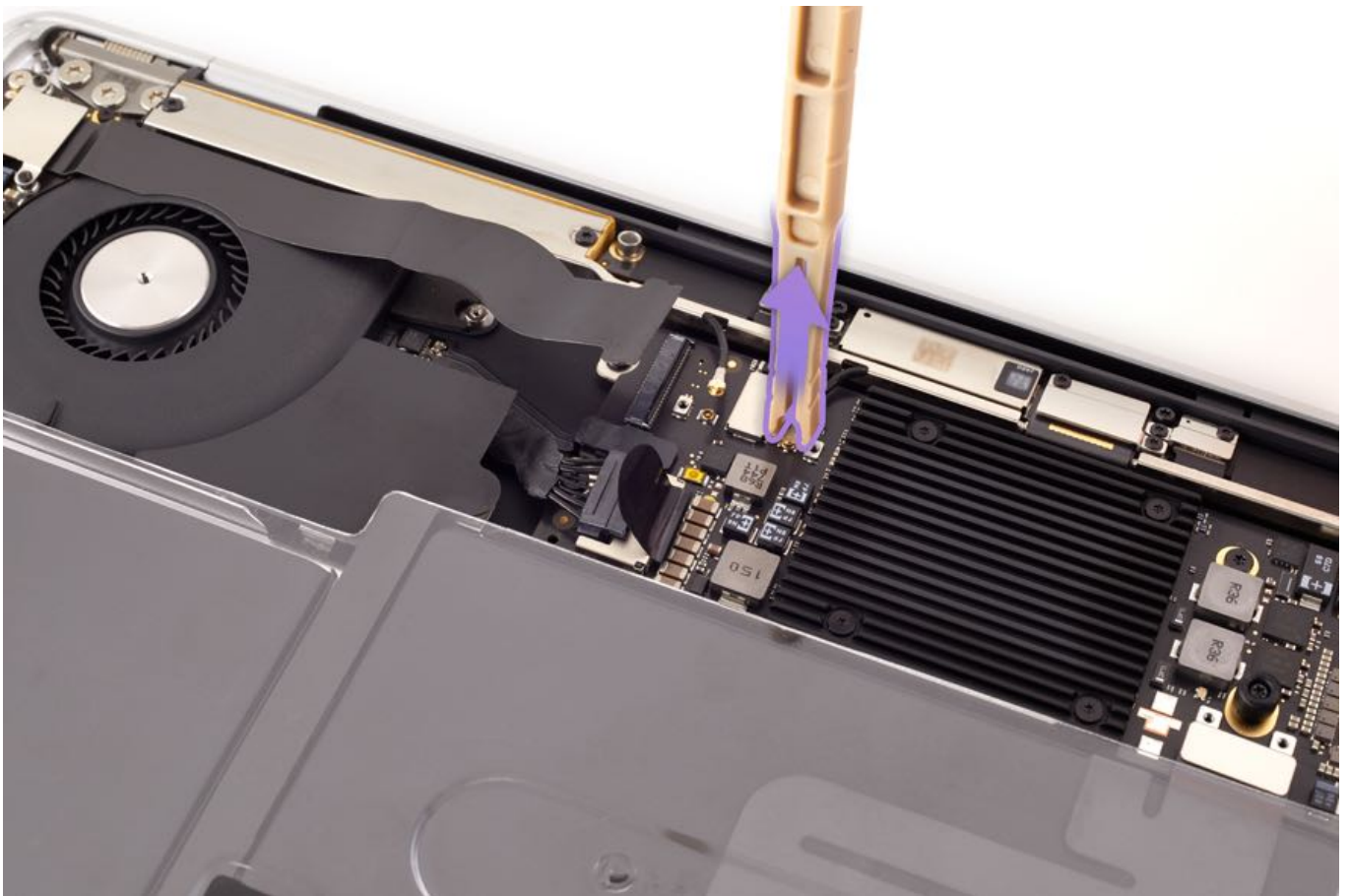


Wireless Antenna Connectors

Example:

- The gold connectors are fragile, so handle them with care.
- To disconnect, grasp behind the connector head with ESD-safe tweezers.
- Lift straight up from the receptacle.
 - Wireless antenna cables

For video instruction, refer to [SV91: Wireless Antenna Connectors Video](#).

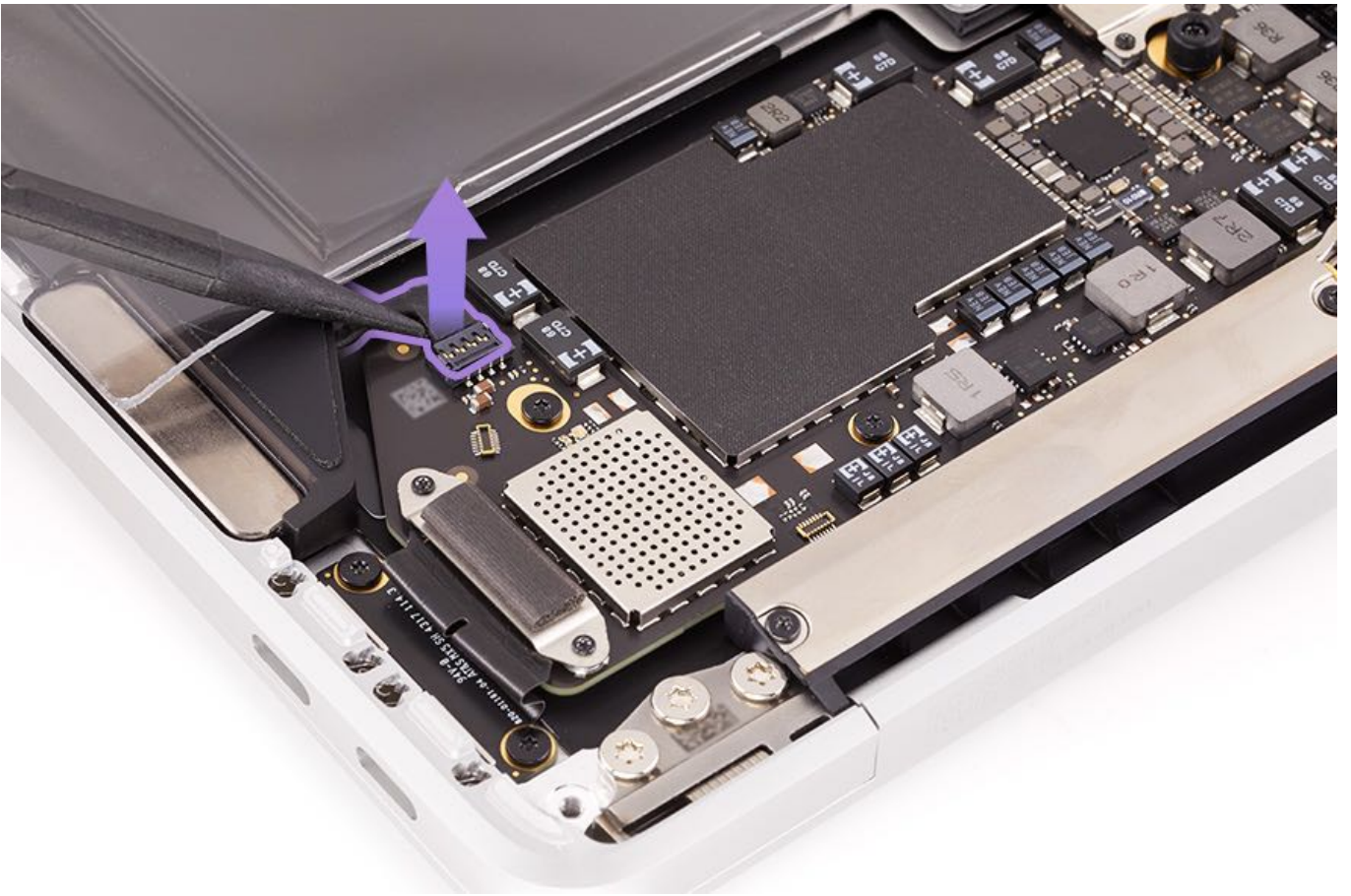


Vertical Insertion (JST)

Below is an example of how to disconnect and reconnect a vertical insertion connector:

- Use a black stick under the cable to remove.
- Keep the connector level to the board when disconnecting and reconnecting.
- Press evenly when reconnecting or connector can be tipped up and not fully seated.
 - Right speaker
 - Left speaker

For video instruction, refer to [SV83: Japan Solderless Terminal \(JST\) Connectors Video](#)



Tools and Fixtures

Tools and Fixtures for MacBook Air (Retina, 13-inch, 2018)

Caution: To prevent scratches or other cosmetic damage to the computer housing, use a soft cloth as a protective layer when removing and installing the external screws.

The following tools are required:

- Clean, soft, lint-free cloth
- ESD-safe workstation, including an ESD mat and wrist or heel strap
- ESD bags (for storing ESD-sensitive parts while removed from the unit)
- Pentalobe screwdriver (923-0731)
- Torx T3 screwdriver (magnetized)
- Torx T5 screwdriver (magnetized)
- Torx T8 screwdriver (magnetized)
- Torque driver, adjustable, 10–34 Ncm (923-02995)
- T5 Bit, 1/4-inch hex, 25 mm (923-02996)
- Torque driver, adjustable, 0.3–1.2 Nm (923-0735)
- Black stick (nylon probe, 922-5065) or other nonconductive nylon or plastic flat-blade tool
- Flat-nosed, ESD-safe tweezers
- Antenna tool (923-01322)
- Ultraviolet Flashlight (923-01604)
- Battery and speaker adhesive (076-00411)

Electrostatic Discharge (ESD) Precautions

Proper ESD precautions must always be used when servicing this product. Make sure you are working on a properly grounded ESD-safe mat and are wearing a properly connected ESD-safe wrist strap.

For more information about ESD, refer to:

- [OP100: Electrostatic Discharge Precautions and Myths](#)
- [ATLAS: ESD Precautions](#)

Fixtures

- Protective battery cover (923-03021)

- iPhone Display Press (661-08916)



- Battery support frame and press plate (923-03007)



- Trackpad gap offset tool (923-02998)

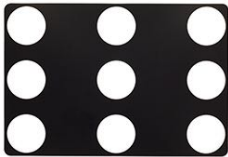


- Trackpad calibration weights, 200g and 800g (923-00462)

Note: Do not store weights above the repair bench. Use the foam packaging in which the weights are shipped for storage in tool drawers.



- Weight Placement Rubber Template (923-02462)



- Touch ID alignment tool kit (923-03032)



Take Apart Procedure Notes

Reassembly Steps

When no replacement steps are listed, replace parts in exact reverse order of Removal procedure.

Note About Images in This Guide

In some cases a pre-production model may have been used to document the procedures in this guide. Although there may be small differences in appearance between the image pictured and the computer you are servicing, the procedures are the same unless noted.

Screw Sizes

All screw sizes shown are approximate and represent the total length of the screw.



System Configuration for Macs with the Apple T2 Security Chip

For Macs with the Apple T2 Security Chip, the repair process is not complete for certain parts replacements until the AST 2 System Configuration suite has been run. Failure to perform this step will result in an inoperative system and an incomplete repair.

- For MacBook Pro (2018): Display assembly, logic board, top case, and Touch ID board
- For MacBook Air (Retina, 13-inch, 2018): Logic board and Touch ID board
- For iMac Pro: Logic board and flash storage
- For Mac mini (2018): Logic board

Important: Before starting this procedure, make sure the customer's current data is backed up.

Notes:

- If the serial numbers are not entered and saved in the repair system correctly, the necessary suites will not become available.
- The serial number must be entered in upper case characters. To ensure accuracy, it is recommended to scan the QR code on the logic board.

Tools:

- Power cord
- USB-C to USB-C Charge Cable included with portables (661-06670) or USB-A to USB-C Apple TV Restore Cable (923-00504)



- Customer's computer with a compatible keyboard and mouse or trackpad connected via USB (desktops only).
- A host computer with:
 - macOS Mojave 10.14 or later and the latest version of iTunes installed.
 - Mac Configuration Utility (MCU) installed. For information on how to set up the host computer, refer to [OP476: Latest Apple Service Toolkit download links and documentation](#).
 - Internet connection.

Steps:

1. Start an AST 2 diagnostic session from an iPad or other device.
2. Connect the customer's computer to the host computer. If the host computer does not have a USB-C port, use a USB-C to USB-A cable. It is important to connect the USB-C cable to the correct port or the process will not run.
 - For notebooks: Use only the USB-C port closest to the caps lock key.



- For iMac Pro: Use only the USB-C port closest to the Ethernet port.



- For Mac mini (2018): Use only the USB-C port closest to the HDMI port.



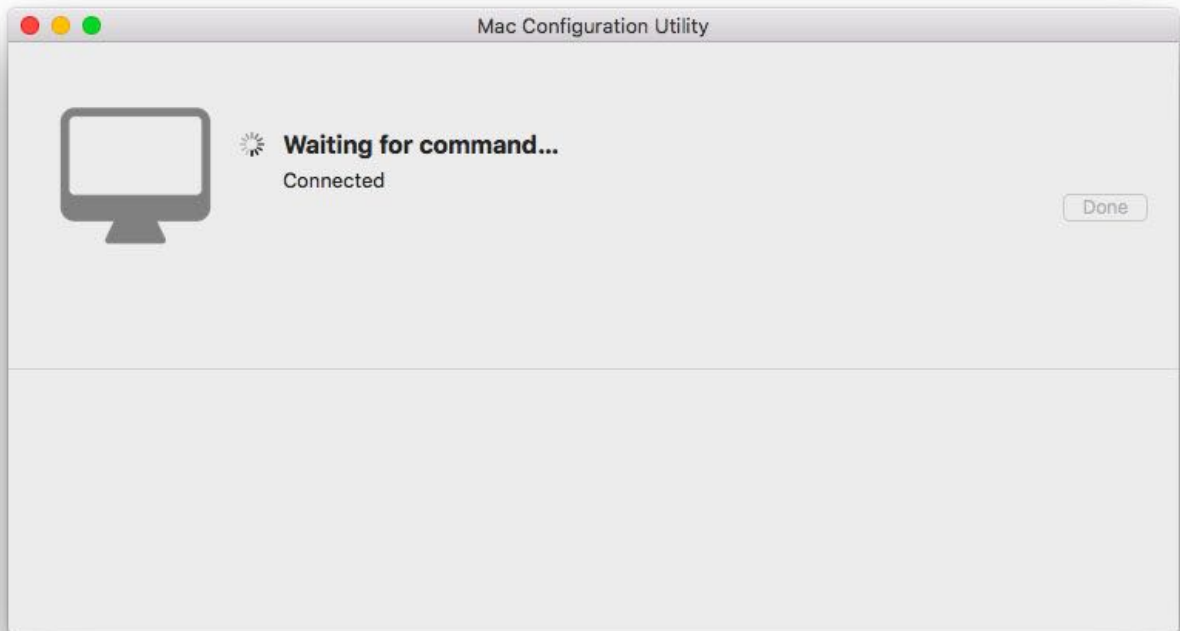
3. Verify that the host computer is turned on, connected to power, and connected to the Internet.

4. Start up the customer's computer in DFU mode.

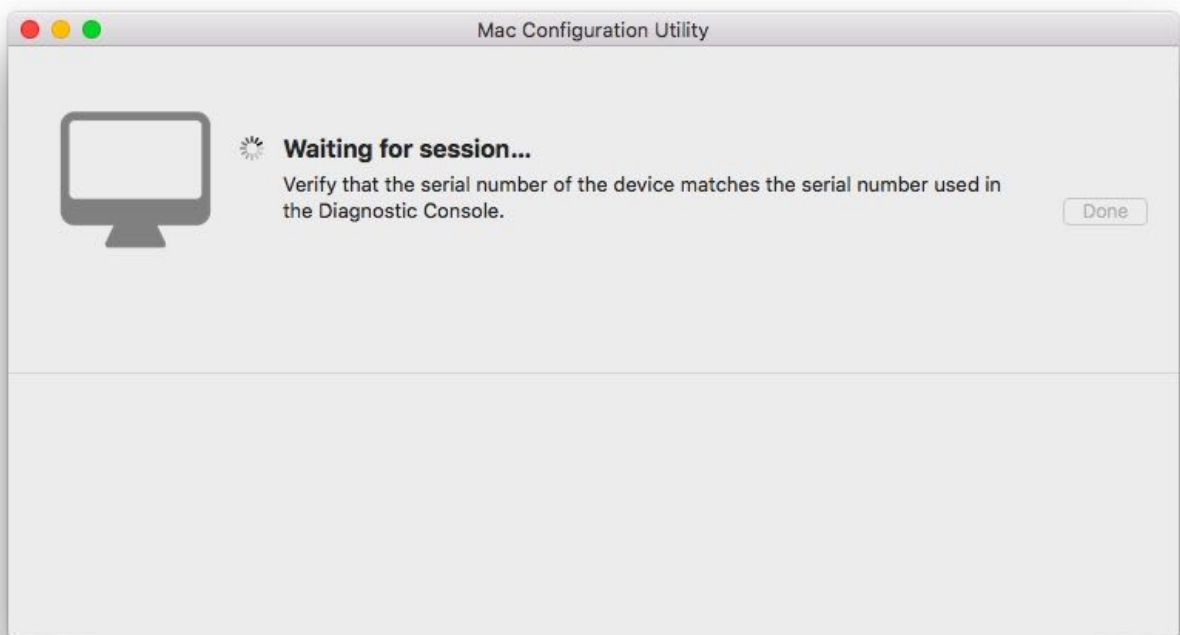
- For desktops: Press and hold the power button on the rear enclosure and connect the power cord. Continue to hold the power button until you see the device appear in Mac Configuration Utility, which may take up to 10 seconds.
- For notebooks: Press and hold the power button, then press and hold Left Control-Left Option-Right Shift until you see the device appear in Mac Configuration Utility, which may take up to 10 seconds.



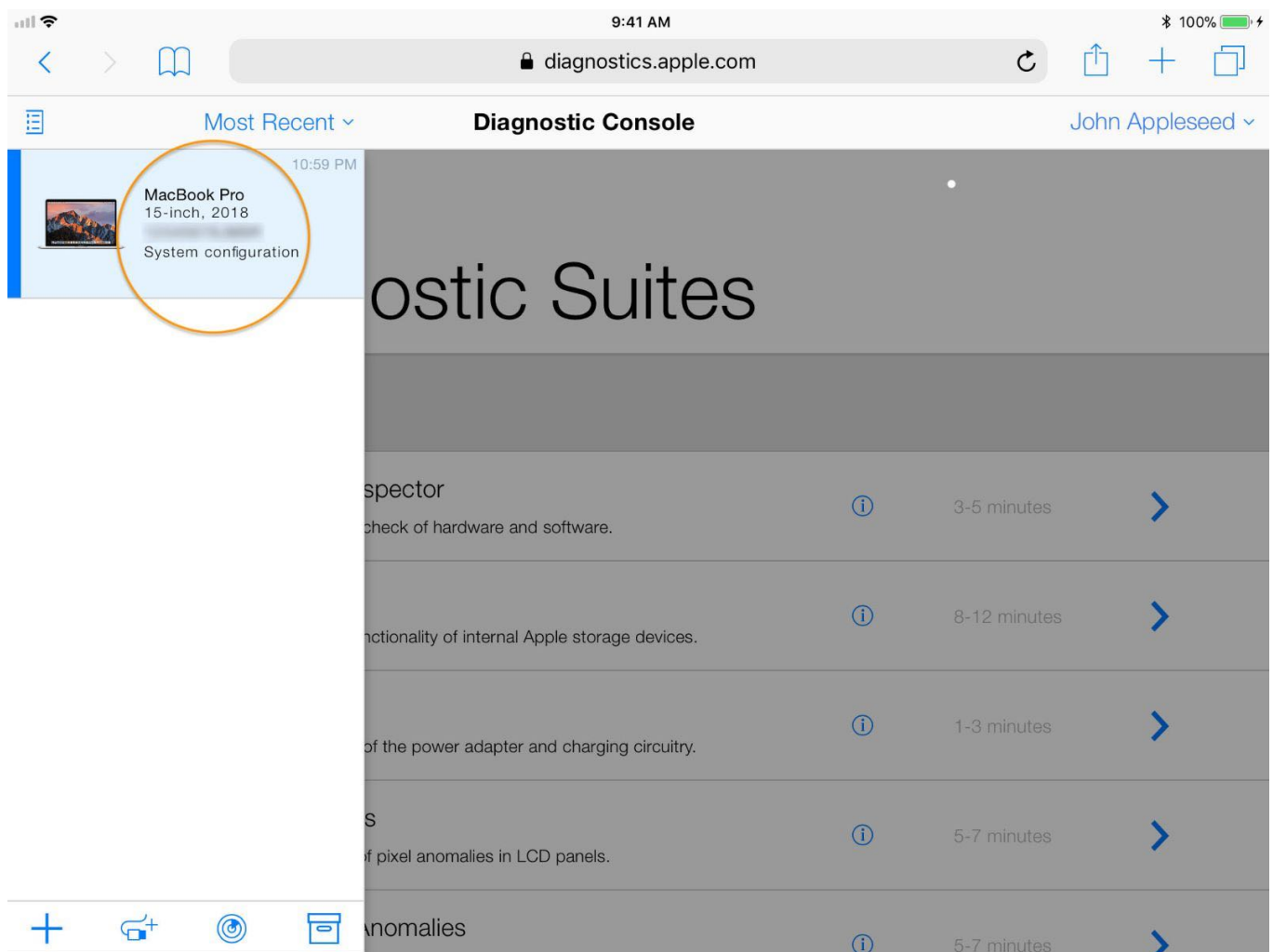
5. MCU will automatically launch and a dialog box will appear on the host computer screen.



Note: If a diagnostic session has not been created yet, this message will appear:



6. Confirm that the customer's computer appears online in the Diagnostic Console. **Note:** If the computer does not appear, the serial number may have been entered incorrectly or the repair was not saved correctly. Both the system serial number and the part serial numbers must be accurate to continue.



7. Choose the System Configuration suite from the Diagnostic Console. **Note:** While the process is running, the customer's display remains blank most of this time. Firmware restoration will take about five minutes.







9:41 AM 100%

diagnostics.apple.com







Diagnostic Console John Appleseed

Diagnostic Suites

POST-REPAIR

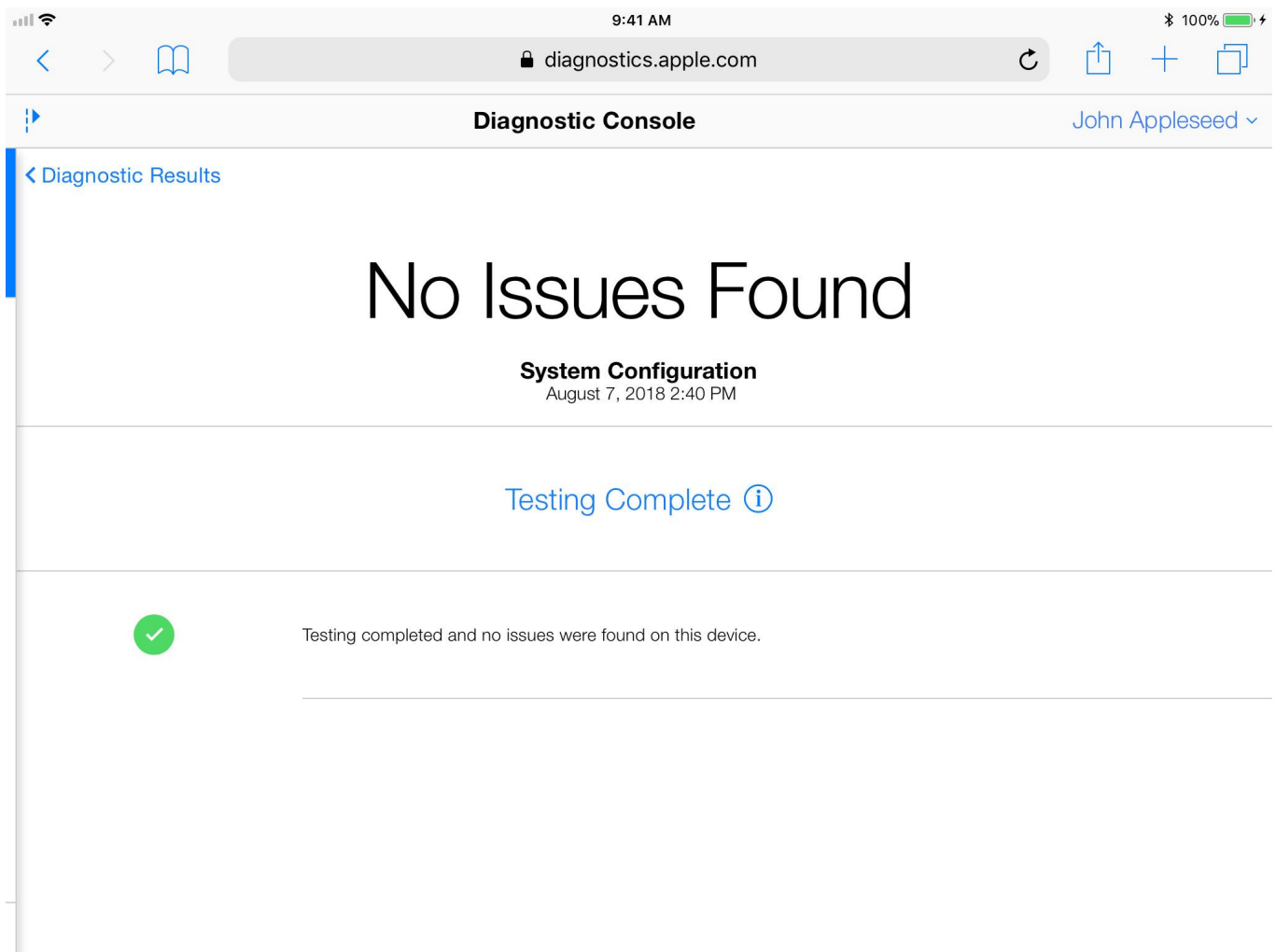
	Full System Diagnostic (EFI) Performs comprehensive testing of hardware functionality and memory module integrity.		30-90 minutes	
	Full System Diagnostic (OS) Performs comprehensive testing of hardware and graphics functionality.		15-30 minutes	

REPAIR COMPLETION

	System Configuration Completes required configuration of applicable service parts and updates firmware after repair. This suite becomes available after service part serial numbers are saved in a repair. For more information refer to TP1657: System Configuration.		1-10 minutes	
	Trackpad Calibration Check Verifies calibration of the trackpad actuator and force sensor. This suite must be run each time the computer is opened and reassembled.		3-7 minutes	

8. Toward the end of the process, the Apple logo and a progress bar will appear.

9. The customer's computer will restart and test results will appear in the Diagnostic Console of AST 2.



10. If no issues found, restart the customer's computer and run MRI and all applicable diagnostics to complete the repair.

Note: For notebooks, macOS does not need to be reinstalled. For desktops, macOS does need to be reinstalled. Shut down the desktop and then restart in recovery mode to install the macOS from Internet Recovery. Internet speeds may adversely impact the ability to restore from Internet Recovery.

11. If issues found:

- Confirm that all setup steps were followed correctly. For information on how to set up the host computer, refer to [OP476: Latest Apple Service Toolkit download links and documentation](#).
- Confirm that serial numbers for all parts, both new and old, were saved correctly into the repair system.
- Archive the AST 2 session, create a new one, and rerun the System Configuration suite.
- Quit and relaunch MCU. If unsuccessful, reboot the host computer.
- Rerun the suite.

Troubleshooting Tips:

If the System Configuration suite is unavailable, check the following:

1. Verify that the new and old service part serial numbers were entered correctly for all parts used and saved into the repair system.
2. Verify that the correct serial number of the customer's computer was entered into the Diagnostic Console.
3. Verify that the serial number of the customer's computer was used to create the repair.
4. Verify that the device is correctly connected to the host Mac and that Mac Configuration Utility is running.
5. A correctly connected device will show as "Apple Mobile Device (DFU Mode)" in System Information > USB.
6. Do not use USB-C to USB-A cable (923-00504) combined with USB-C to USB Adapter (MJ1M2AM/A).

If the device goes offline while running System Configuration or the suite does not complete, check the following:

1. Archive the AST 2 session, create a new one, and rerun the System Configuration suite.
2. Restart the host Mac.
3. Open the device and confirm that all internal components were properly installed.
4. Check for system outages.

Bottom Case

First Steps



Warning:

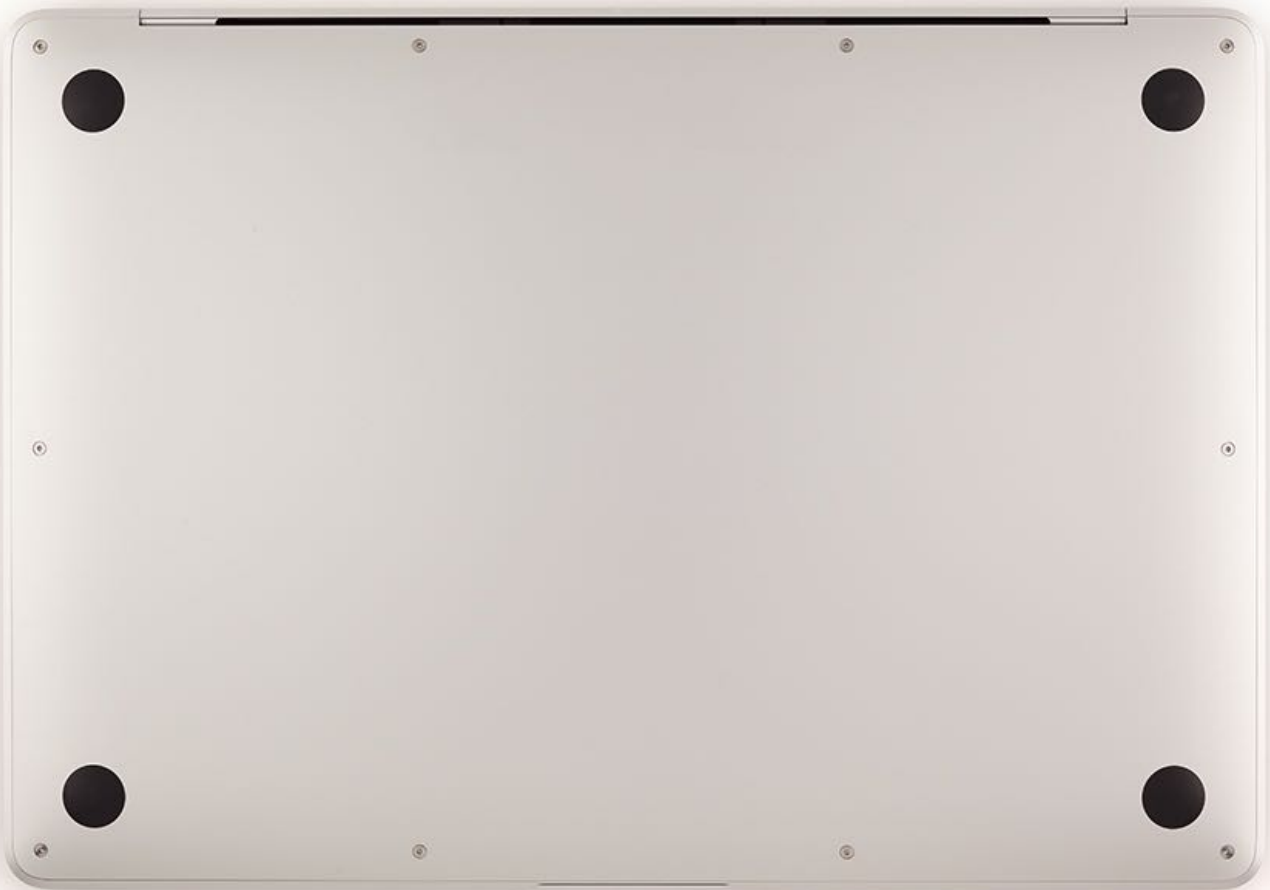
- Attach the battery cover and disconnect the battery immediately after removing the bottom case.
- Do not apply external power while the computer is under repair.

Important:

- Only Apple-certified technicians should perform this procedure. For more information, refer to [OP1859: About Apple service certifications](#).
- Wear an ESD wrist strap and take precautions to avoid ESD.

Before you begin:

- Shut down computer.
- Unplug all cables.
- Put on ESD strap.
- Place computer face down on a clean, flat surface.



Tools

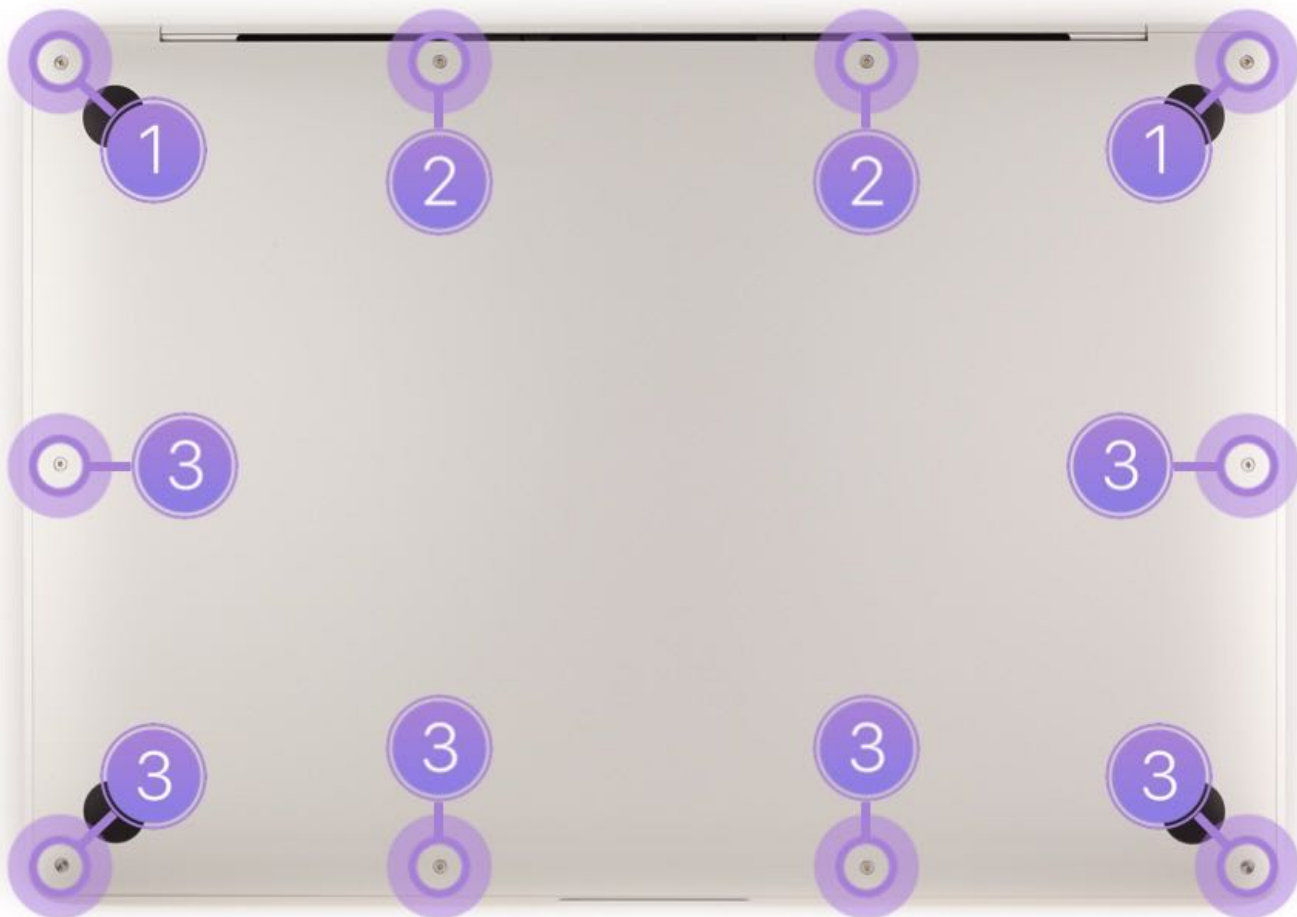
1. Pentalobe screwdriver
2. Black stick



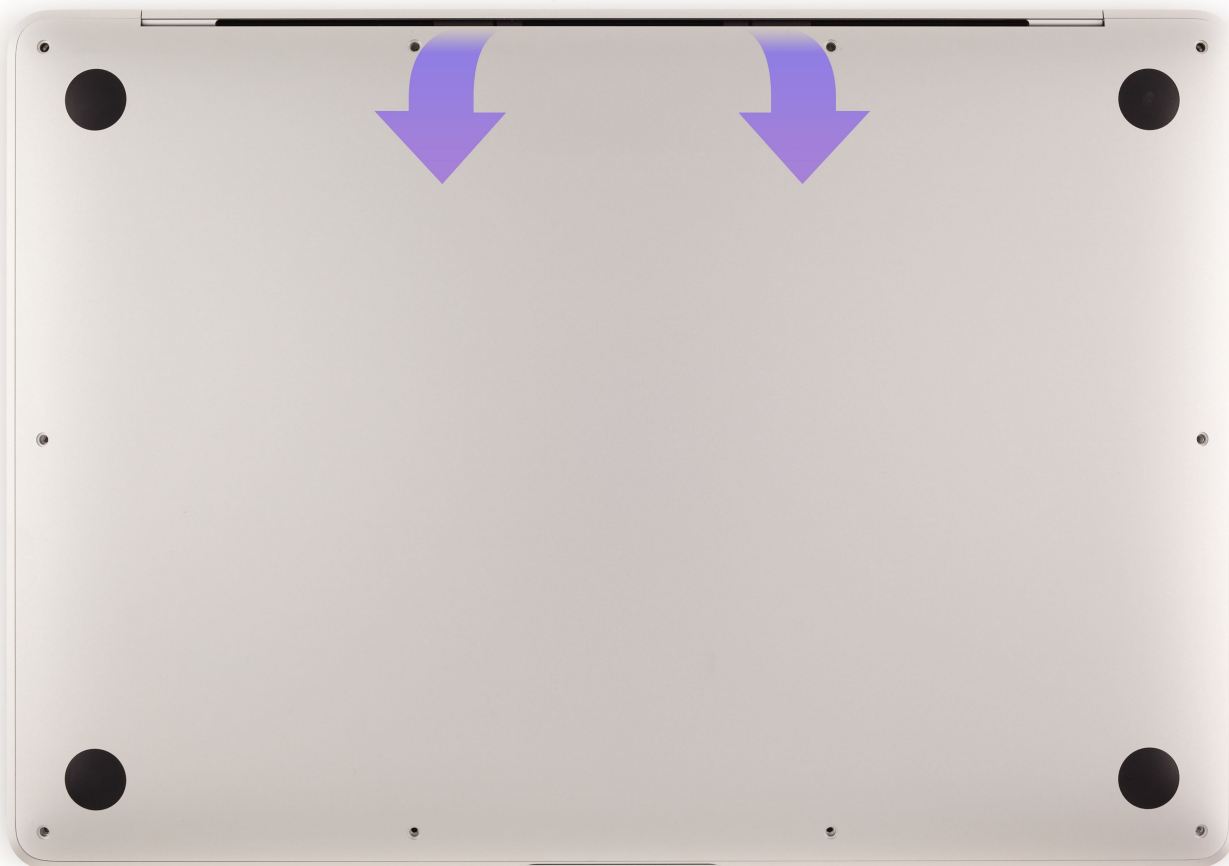
Steps For Removal

1. Remove 10 Pentalobe security screws:

Part Number	Color	Location	Screw
923-02815	Space Gray	1	
923-02816	Space Gray	2	
923-02814	Space Gray	3	
923-02818	Silver	1	
923-02819	Silver	2	
923-02817	Silver	3	
923-02821	Gold	1	
923-02822	Gold	2	
923-02820	Gold	3	

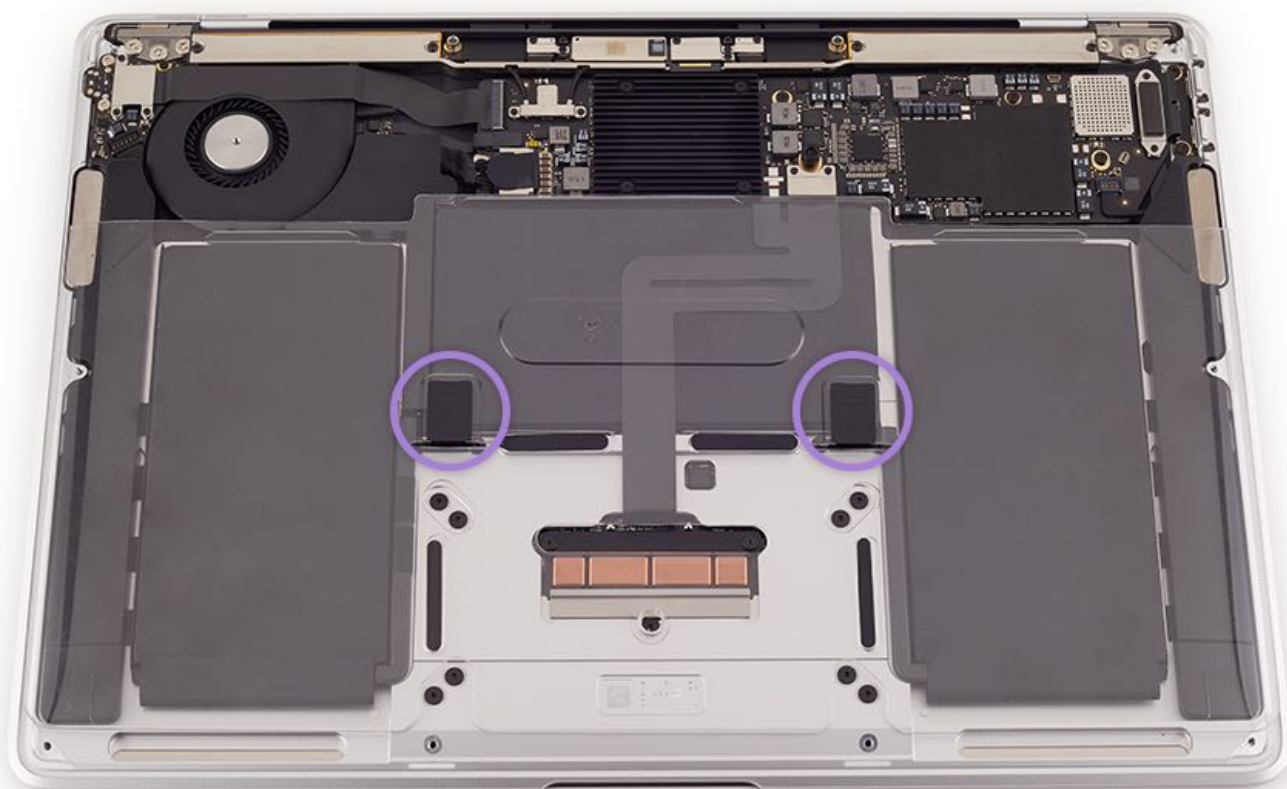


2. Lift from the top and remove bottom case.

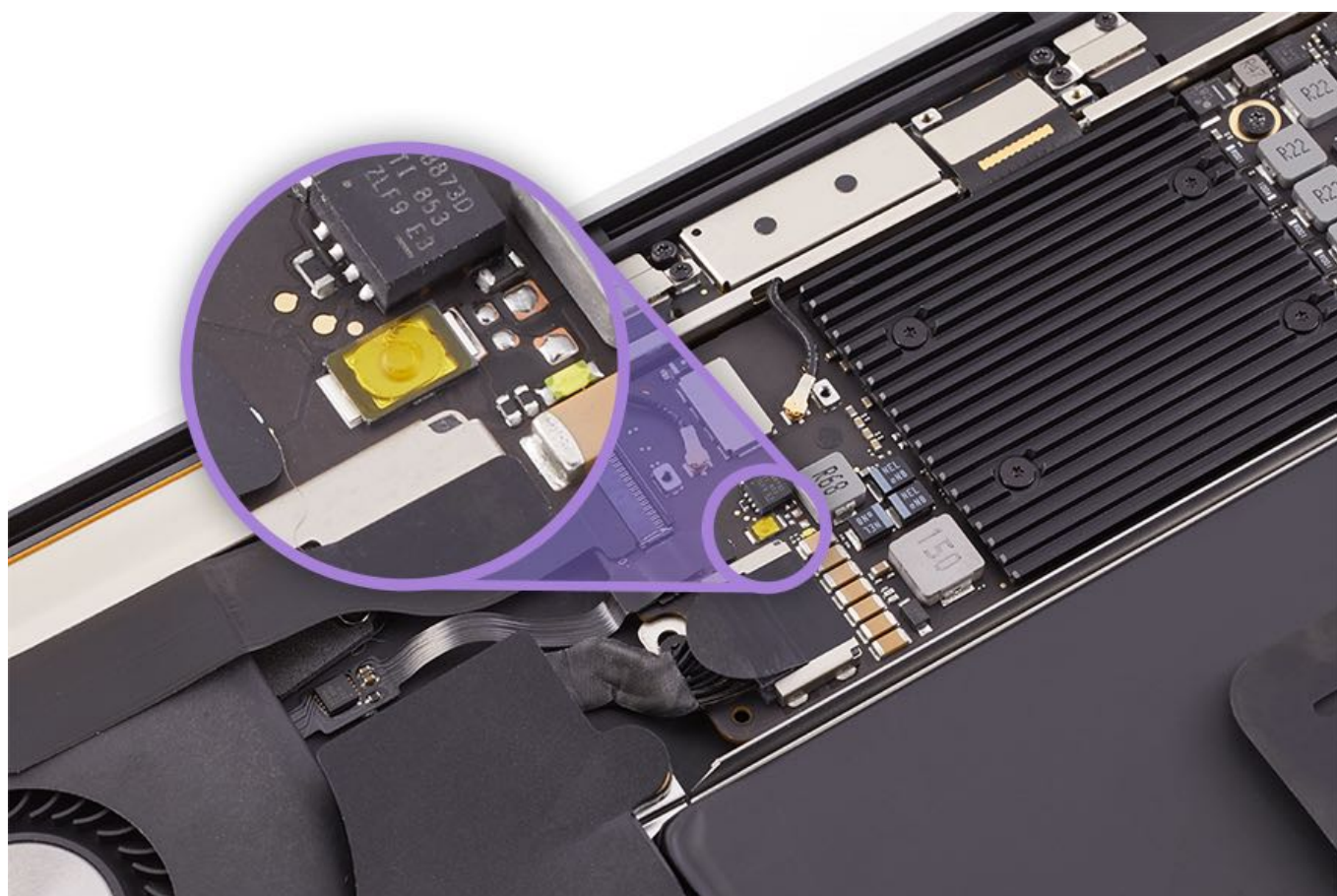


Warning: Immediately after removing bottom case, always attach battery cover (923-03021) and disconnect battery cable from logic board.

3. Align and attach the battery cover. Make sure the metal clips are secure.



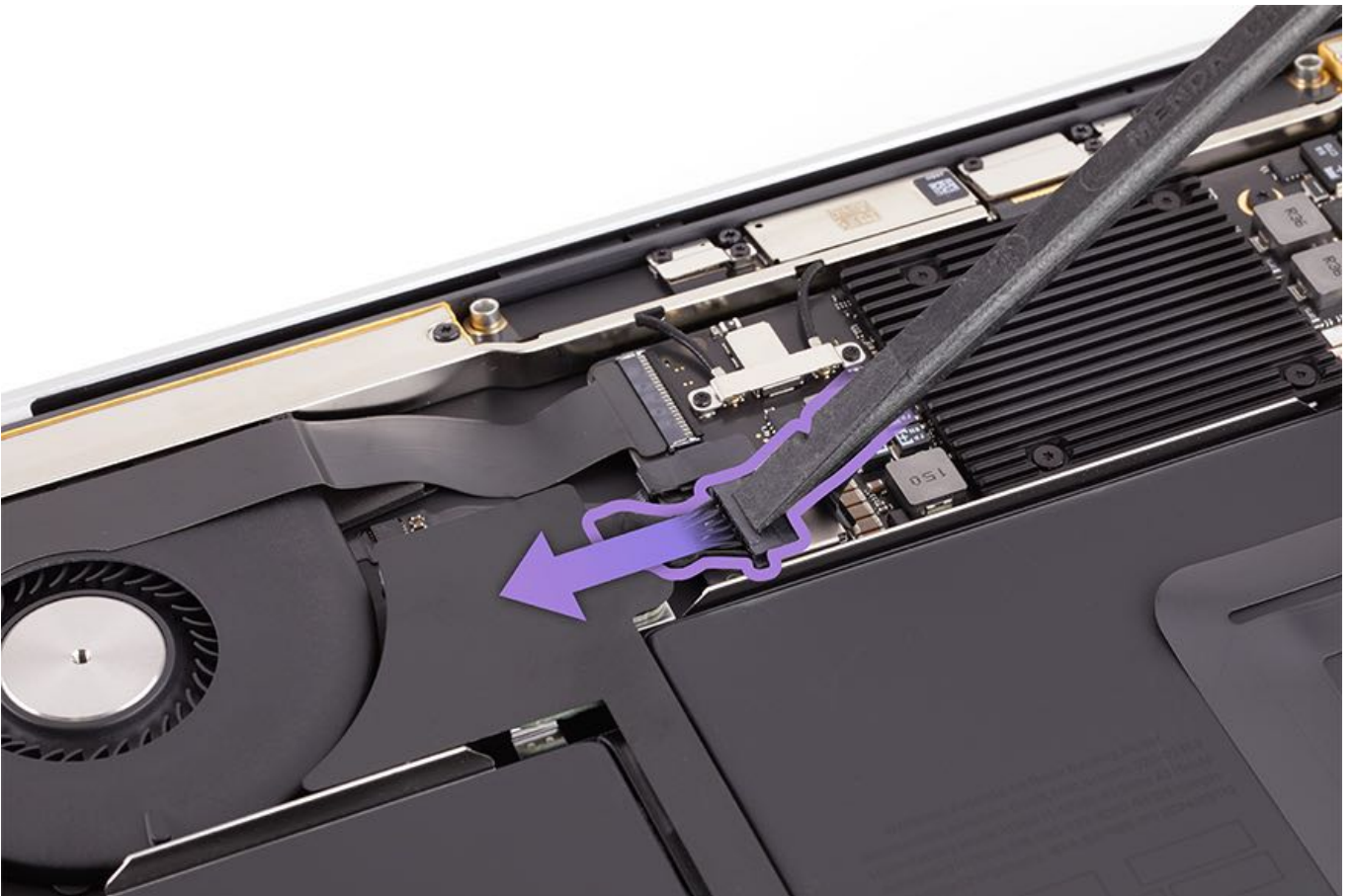
4. Locate the power button on the logic board.



5. With a black stick, press the power button for five seconds to disengage power.



6. Disconnect the battery cable from the logic board.

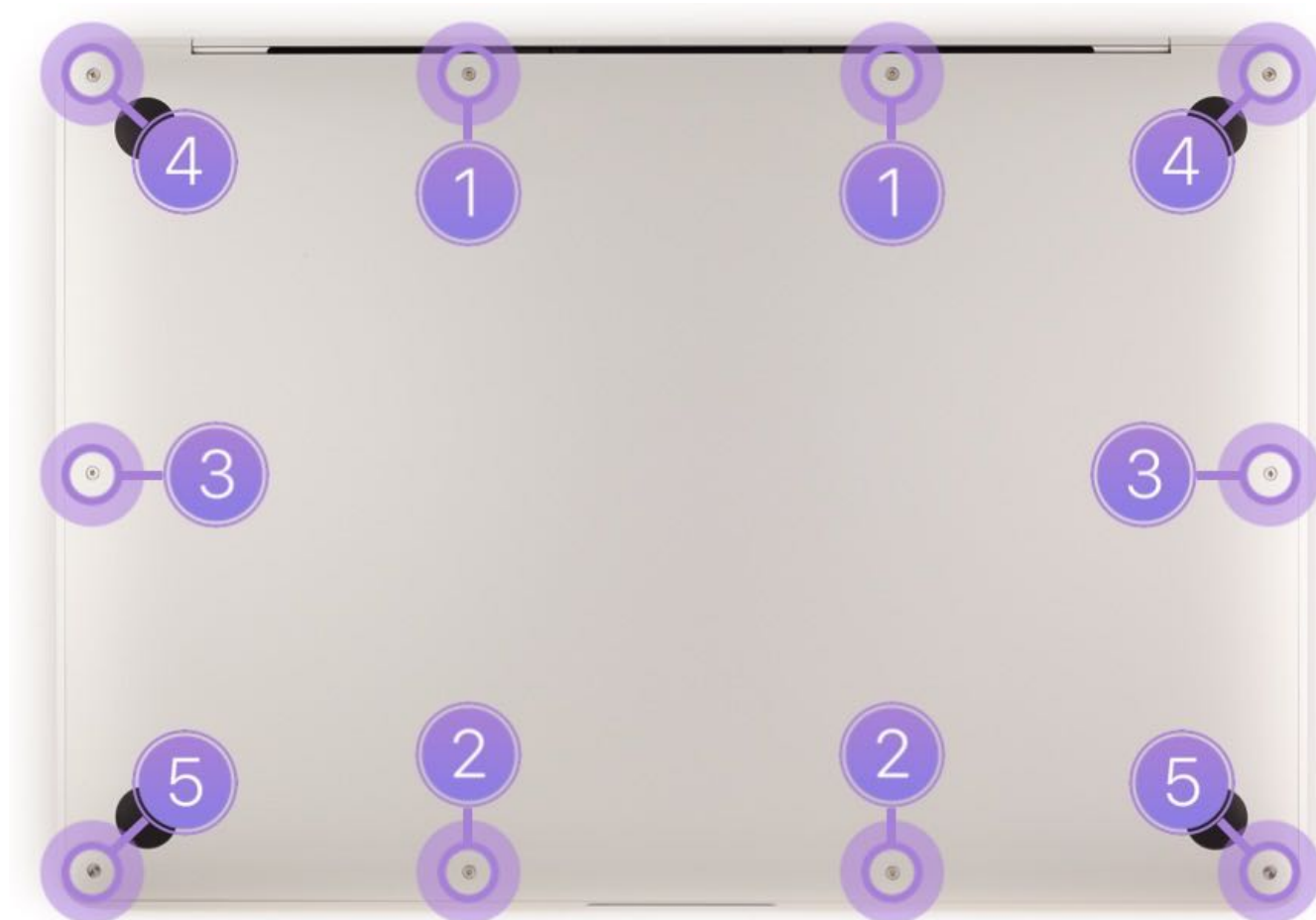


Steps For Reassembly

Note: If you are installing a replacement bottom case, use a fine-tipped permanent marker to write the original system serial number inside the bottom case.

1. Make sure bottom case interior is clean and free of debris.

2. Reconnect battery cable to logic board.
3. Remove battery cover from battery.
4. Reinstall bottom case. Press lightly to ensure bottom case snaps into place.
5. Confirm all screw holes are aligned before installing screws.
6. Install screws in the order shown.



7. Verify the trackpad performance with Trackpad Calibration Check. For instructions on trackpad calibration, refer to [TP1314: Trackpad Calibration Check](#).

Logic Board

First Steps



Warning:

- Attach the battery cover and disconnect the battery immediately after removing the bottom case.
- Do not apply external power while the computer is under repair.

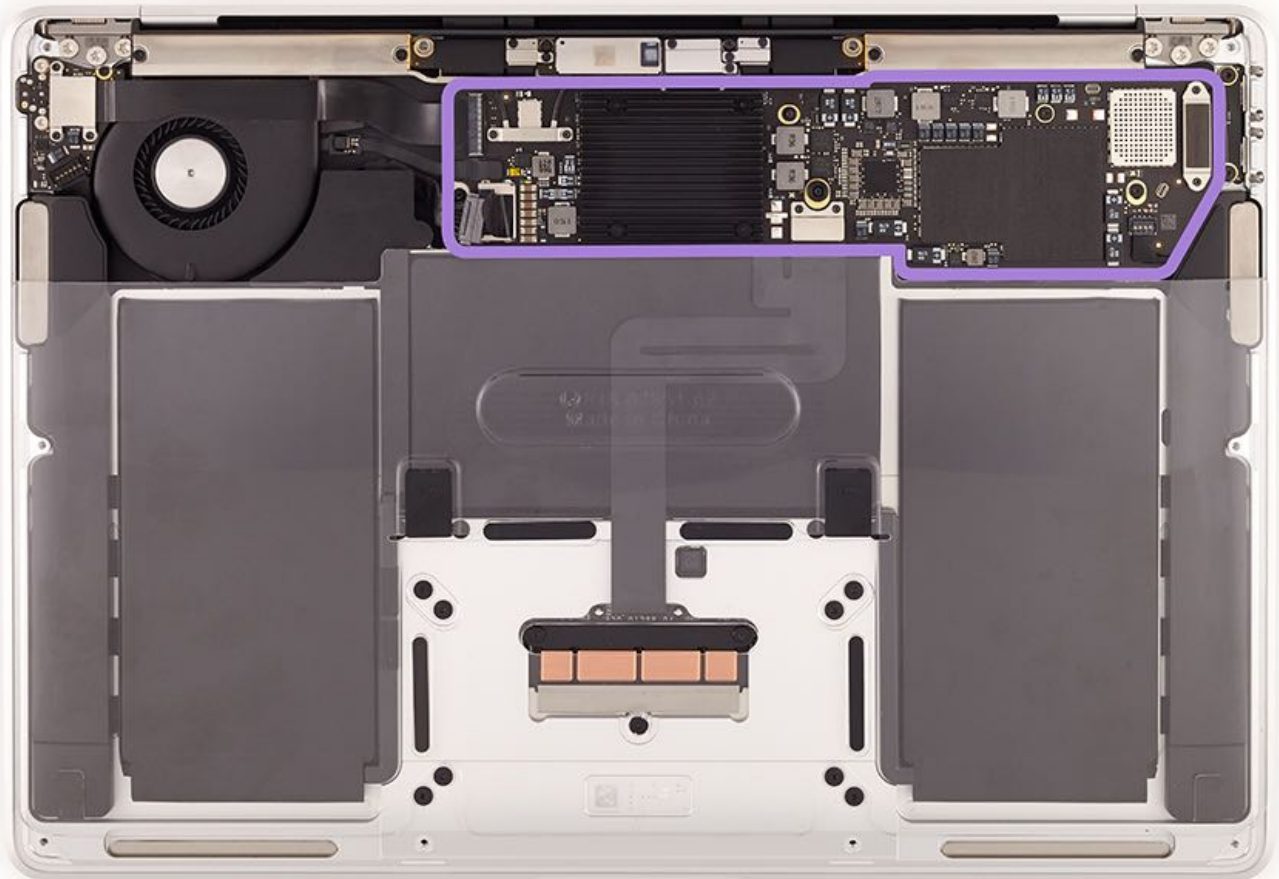
Important:

- Only Apple-certified technicians should perform this procedure. For more information, refer to [OP1859: About Apple service certifications](#).
- Wear an ESD wrist strap and take precautions to avoid ESD.

Remove:

- [Bottom Case](#)

For video instruction, refer to [SV394: Logic Board Replacement Video](#).



Tools

1. Torx T3 screwdriver
2. Torx T5 screwdriver
3. Antenna tool (923-01322)
4. Black stick

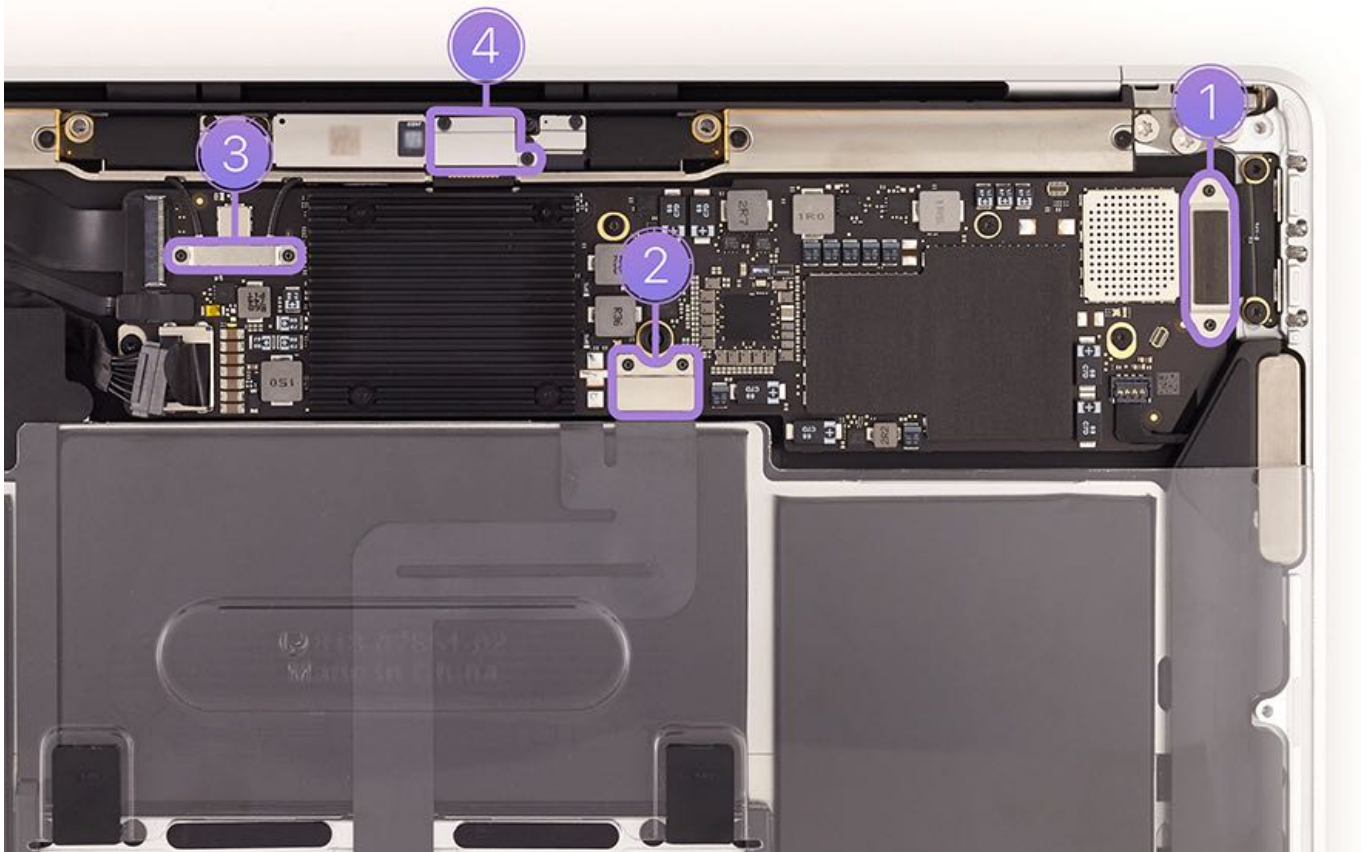


Steps For Removal

1. Remove the T3 screws from the following four cowlings. Set the cowlings aside for reuse.

1. I/O board cowling
2. Trackpad flex cable cowling
3. Wireless Antennas cowling
4. ePD flex cable cowling

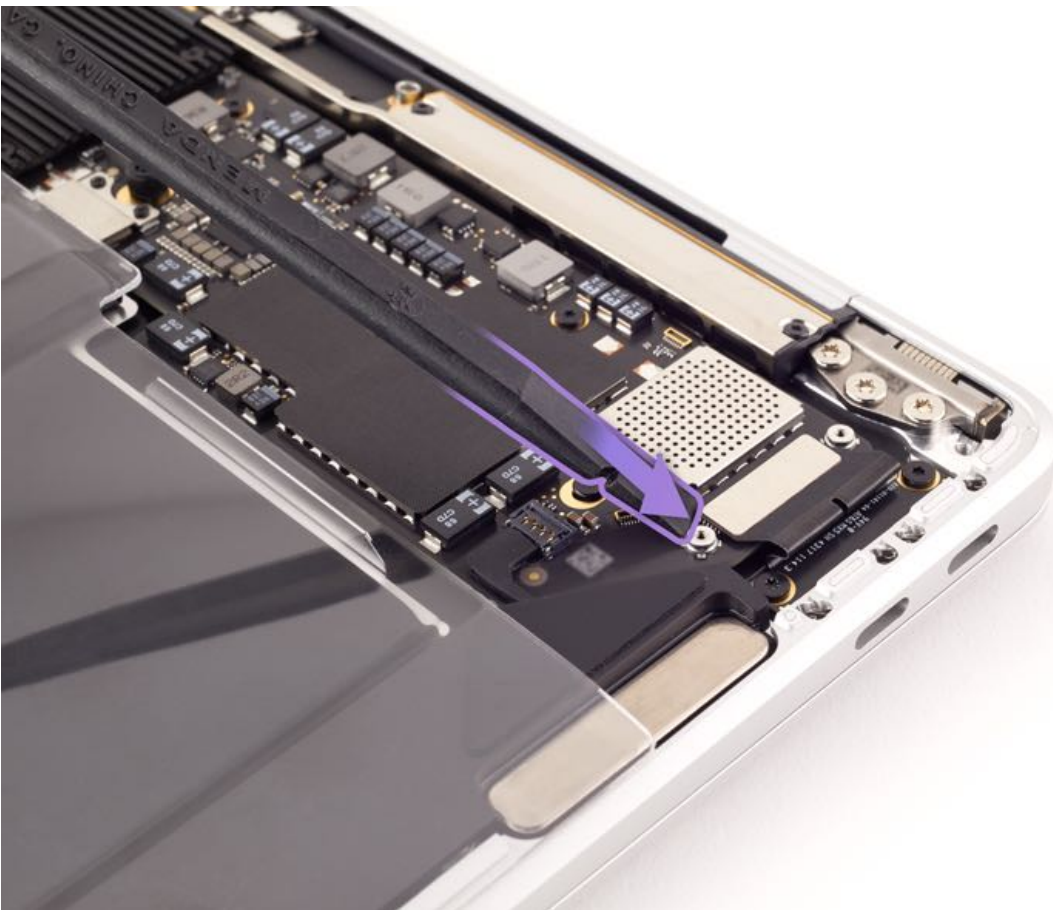
- T3: 923-02885



2. With the corner of the black stick, disconnect the I/O board flex cable from the logic board.

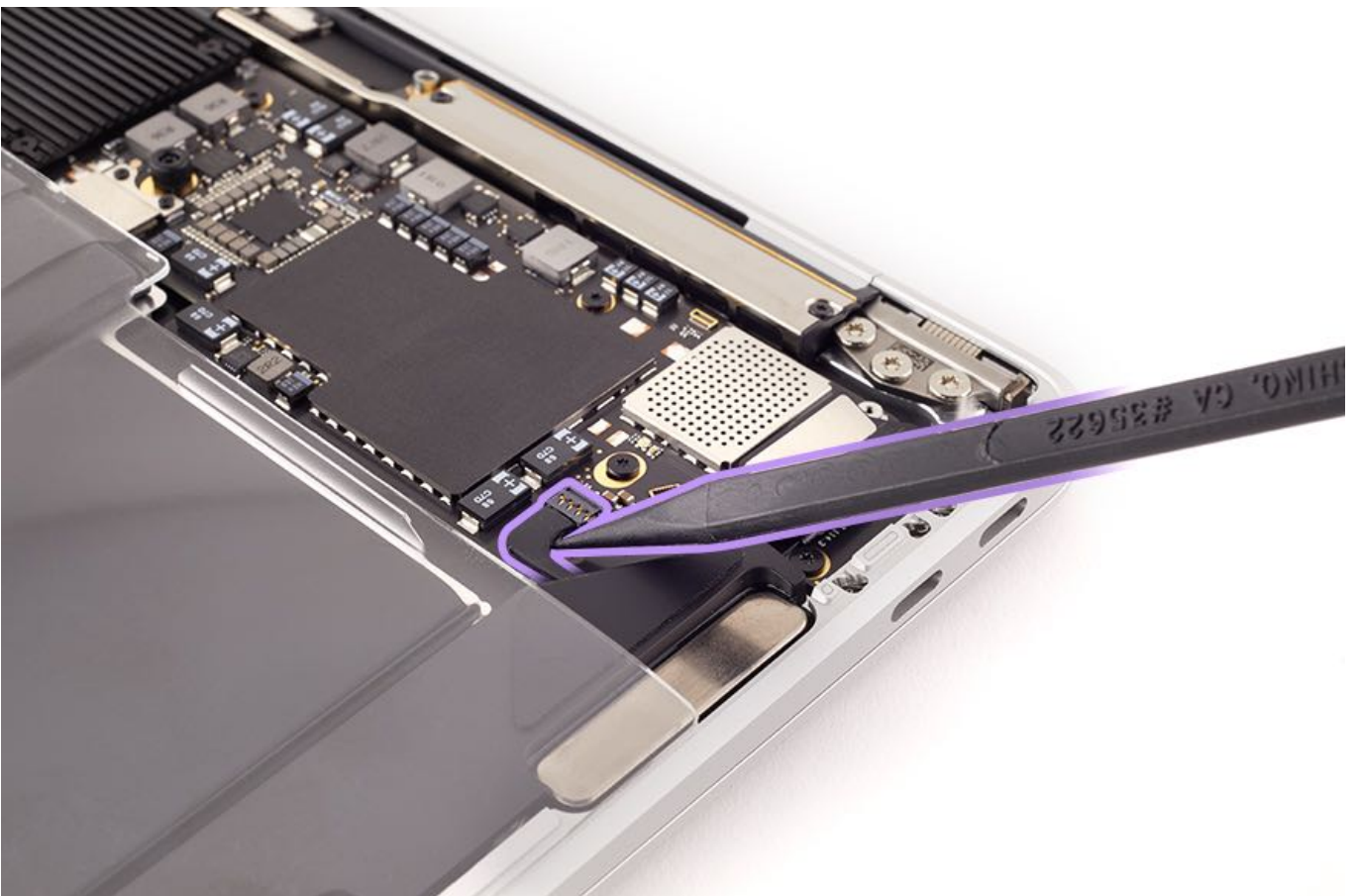


Caution: Be sure to lift from the corner of the connector. Inserting the black stick directly into the middle of the connector may damage components.



3. Continue to disconnect the following cables from the logic board:

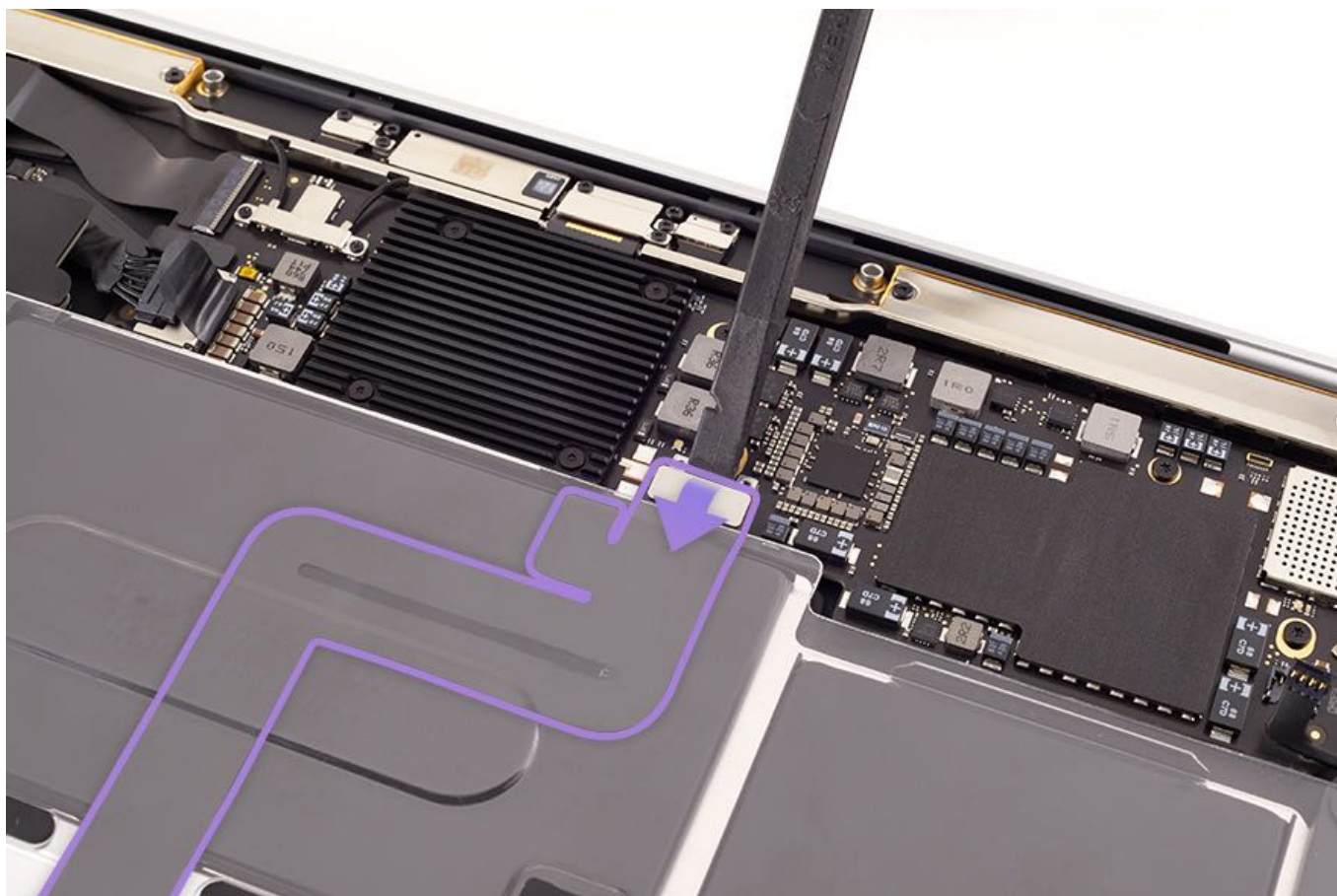
- Right speaker flex cable



- Audio board flex cable

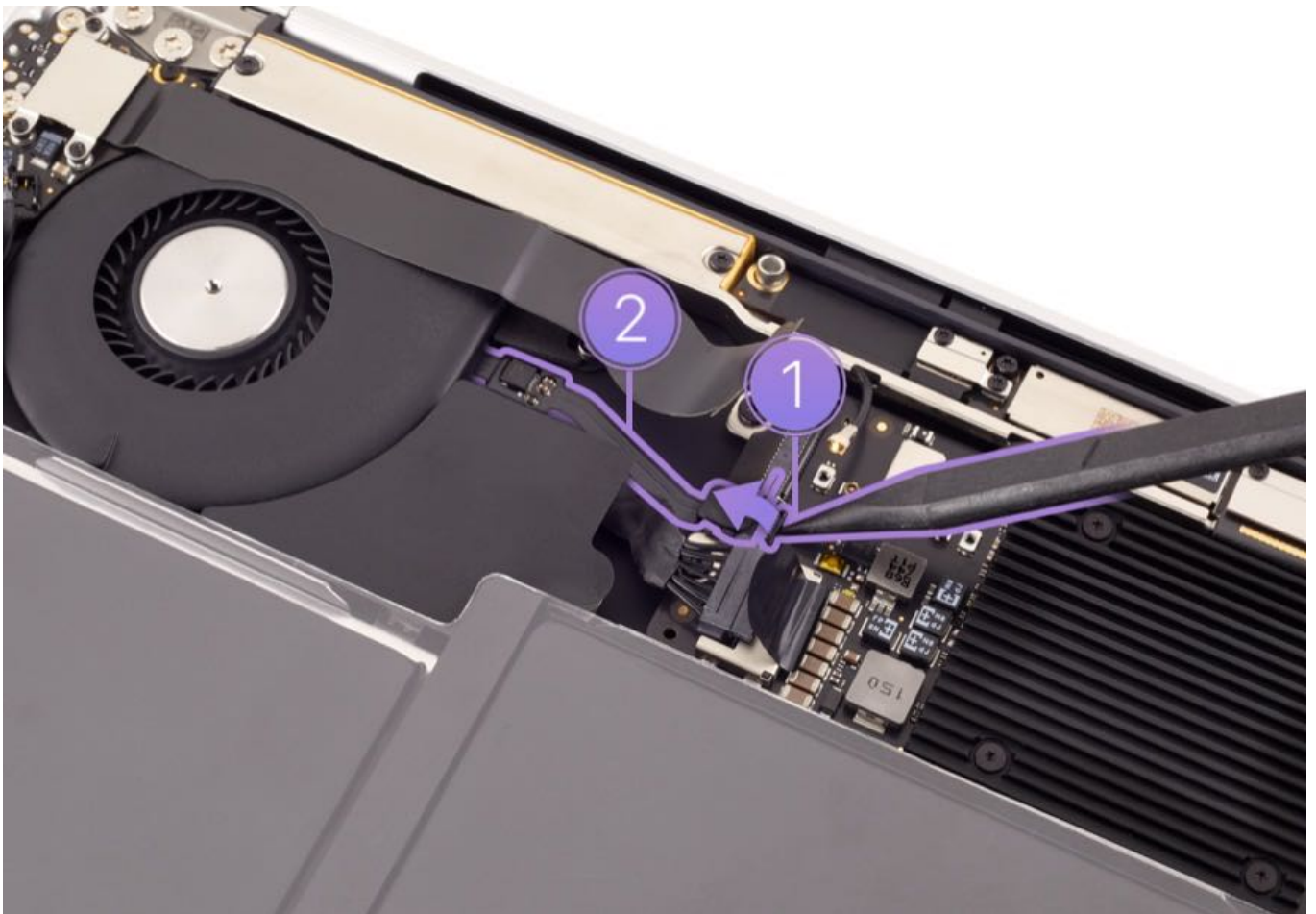


- Trackpad flex cable



- Fan flex cable

Note: Lift the locking lever and disconnect the flex cable (1), then loosen the adhesive (2).



4. Using the antenna tool, disconnect the two wireless antennas from the logic board.



5. Disconnect the eDP flex cable from the TCON board.



6. Remove the six T5 screws from the logic board.

- T5: 923-02892 (2) (position 3)

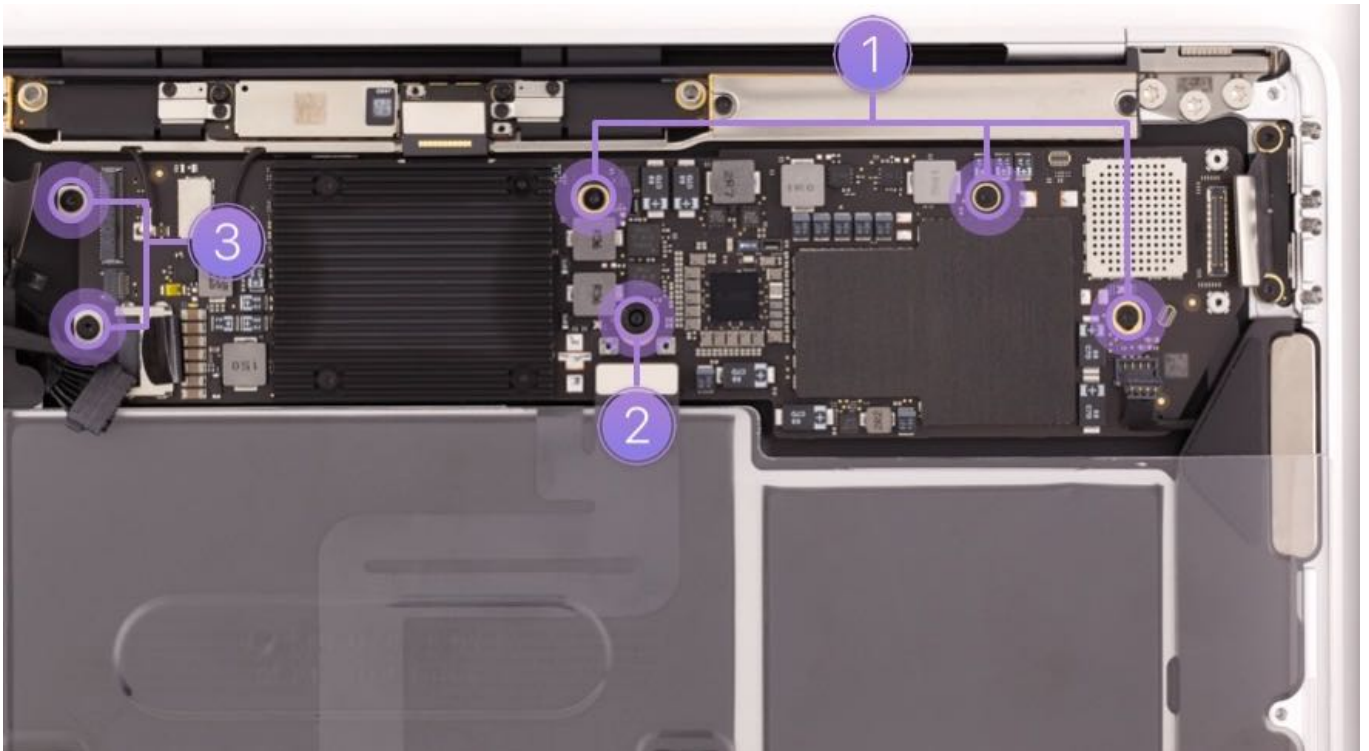


- T5: 923-02893 (1) (position 2)



- T5: 923-02891 (3) (position 1)





7. Tilt up the logic board and slide the board out of the top case.

Caution: Hold the logic board by the edges and do not touch the gold pins.

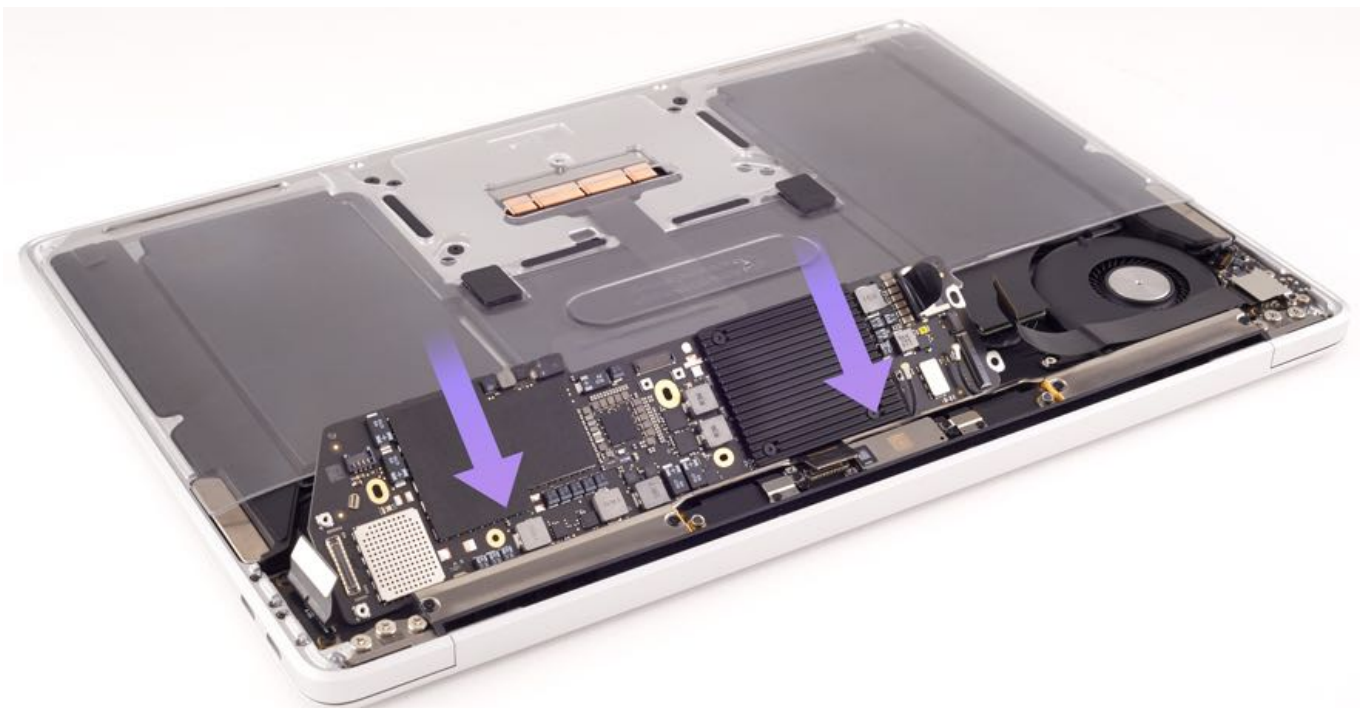
Steps For Reassembly



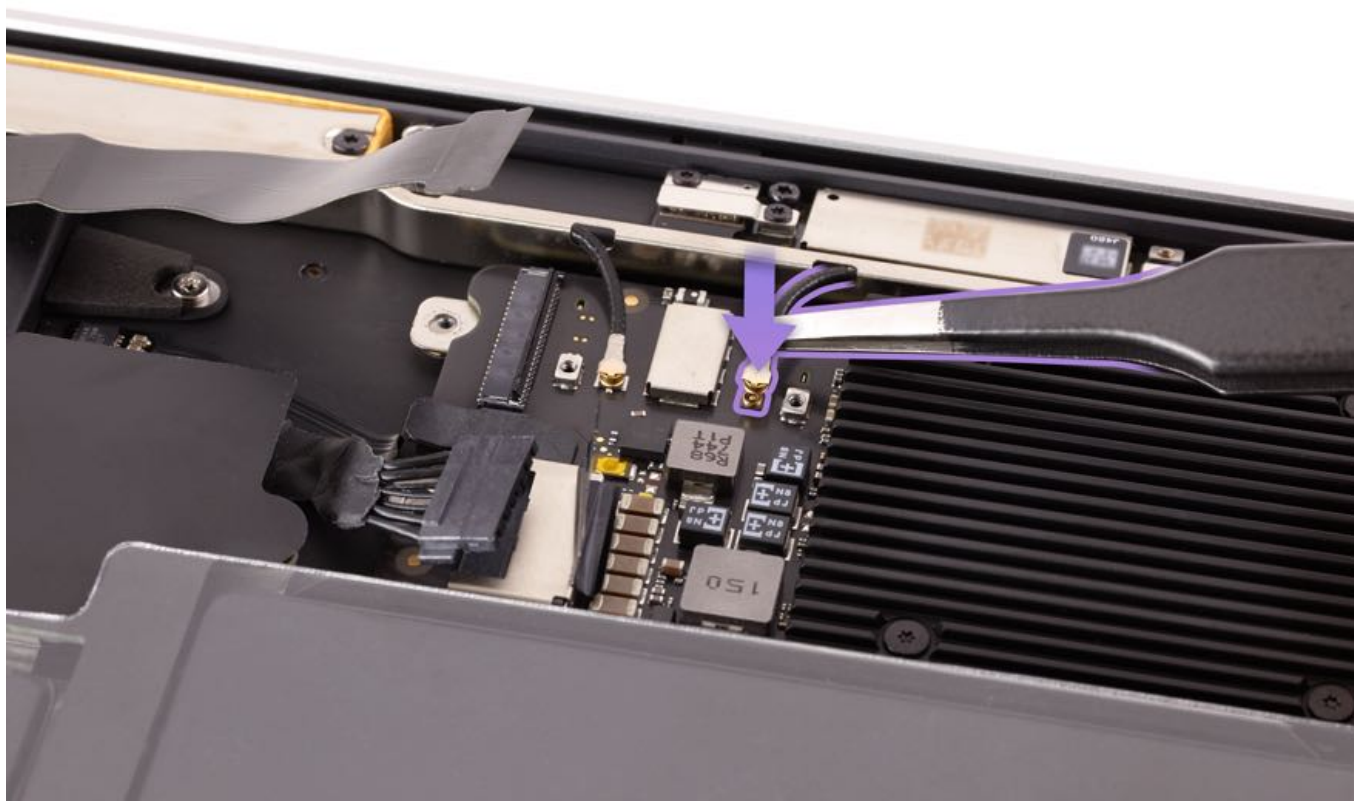
Caution:

- Be sure no cables are caught under the logic board before attaching the antennas and screwing down the logic board. Bending the cables under the board can cause damage to the cables.
- Hold the logic board by the edges and do not touch the gold pins.
- If installing a replacement logic board, be sure to transfer the eDP flex cable to the new board.

1. Place the logic board back into the bottom case.



3. When reconnecting the antennas, use tweezers to align the antenna head with the connector on the logic board. Then use the flip side of the antenna removal tool to make the connection.



- T5: 923-02892 (2) (position 3)

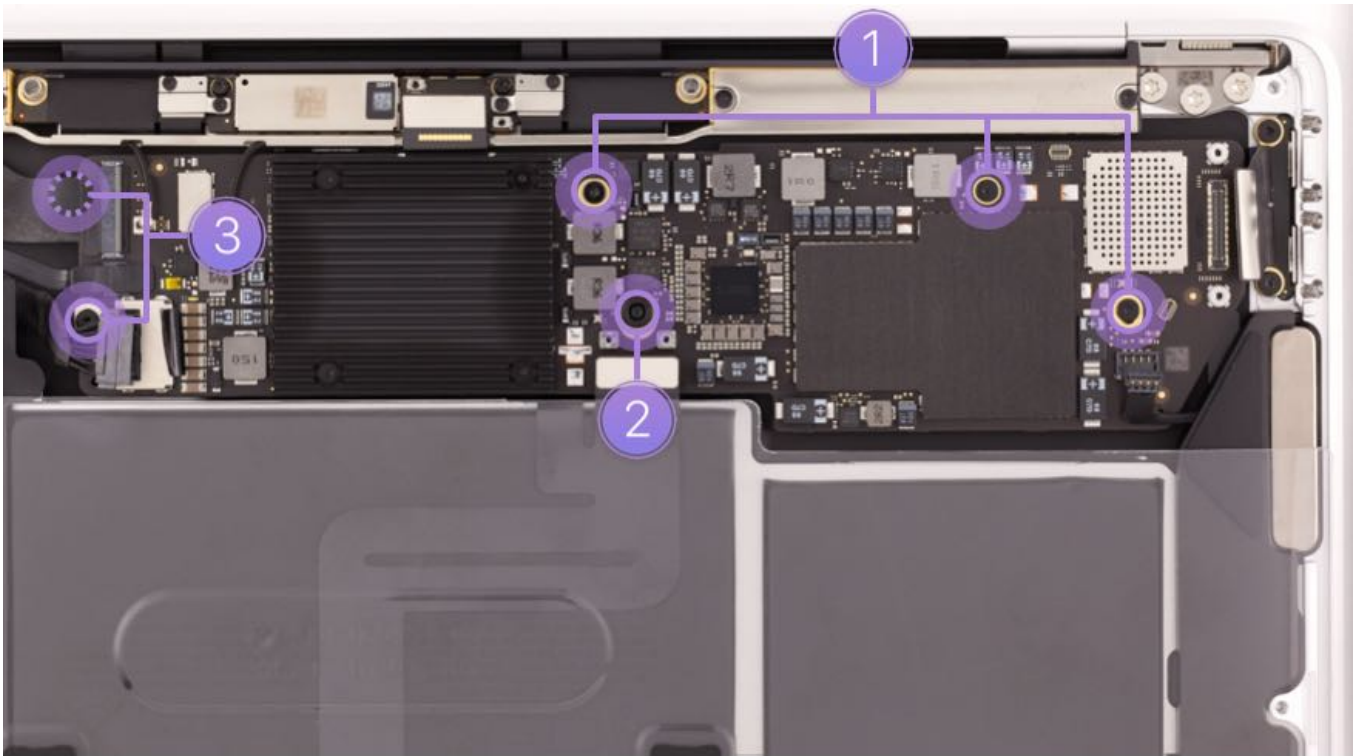


- T5: 923-02893 (1) (position 2)

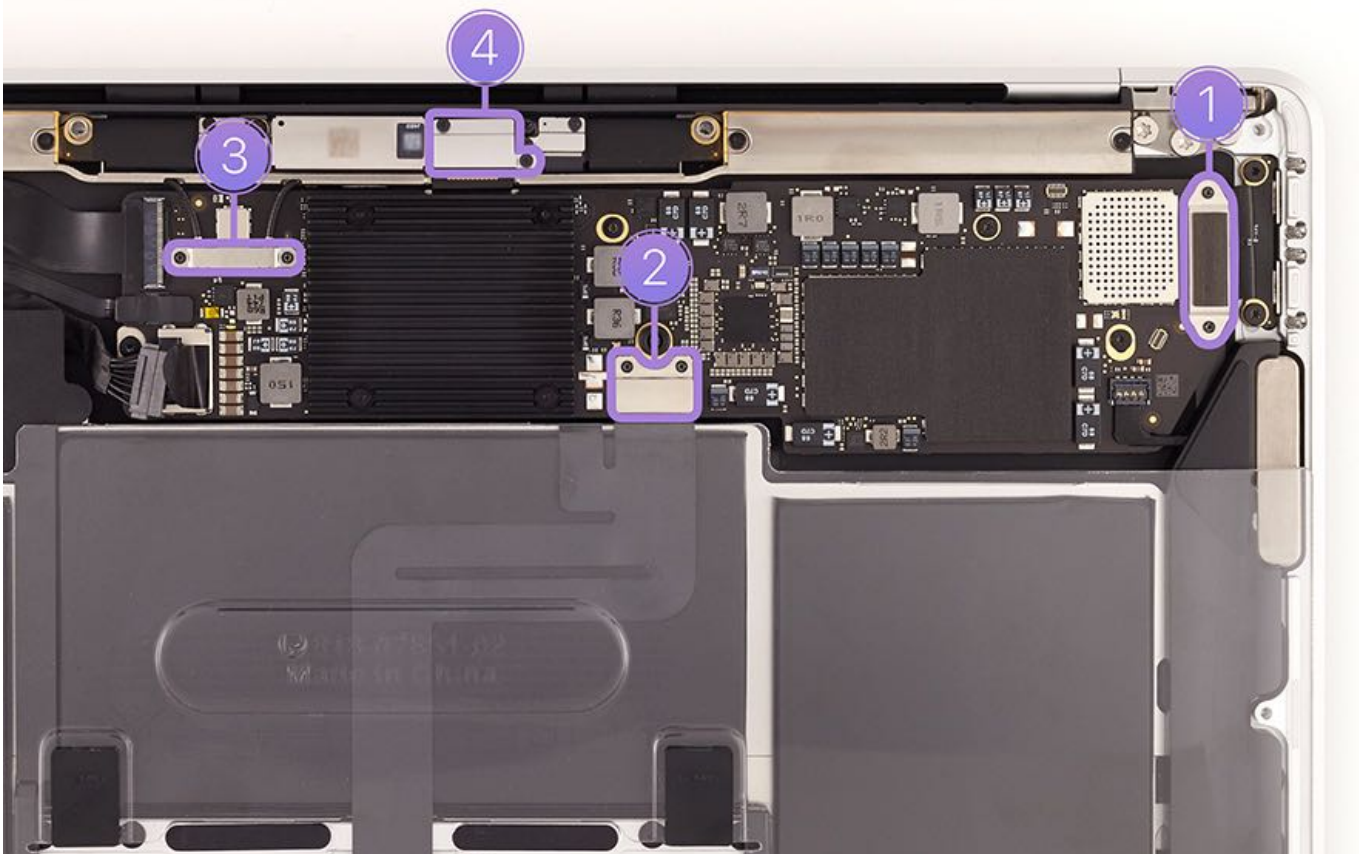


- T5: 923-02891 (3) (position 1)





5. Reinstall the flex cable cowlings.



Important:

- If the logic board is replaced, the [Touch ID board](#) must also be replaced.
- If you are installing a replacement logic board, remove and transfer the [eDP flex cable](#) to the new logic board.

6. Reinstall the [bottom case](#).



7. **Caution:** This repair is not complete until System Configuration has been performed. For instructions, refer to [TP1657: System Configuration for Macs with the Apple T2 Security Chip](#). Failure to perform this step will result in an inoperative system and an incomplete repair.

8. After System Configuration is performed, verify the trackpad performance with Trackpad Calibration Check. For instructions on trackpad calibration, refer to [TP1314: Trackpad Calibration Check](#).

Reinstalling Software That Came with the Computer

Reinstalling Software That Came with the Computer

This procedure requires an Internet connection.

Note: In some situations, a user may have set a firmware password. The user must know the firmware password in order to reinstall OS X or macOS. If the user cannot remember the password, then refer to the technician instructions in [HT204455: How to set a firmware password on your Mac](#).

Important: Apple recommends that users back up their data before any software restore procedure. Back up essential files before installing OS X or macOS. Apple is not responsible for any loss of data. For instructions on using Time Machine, refer to [HT201250: How to use Time Machine to back up or restore your Mac](#).

For instructions on reinstalling the OS, follow the steps in [HT204904: How to reinstall macOS](#).

For more information about recovery mode, refer to [HT201314: About macOS Recovery](#).

Vent/Antenna Module

First Steps



Warning:

- Attach the battery cover and disconnect the battery immediately after removing the bottom case.
- Do not apply external power while the computer is under repair.

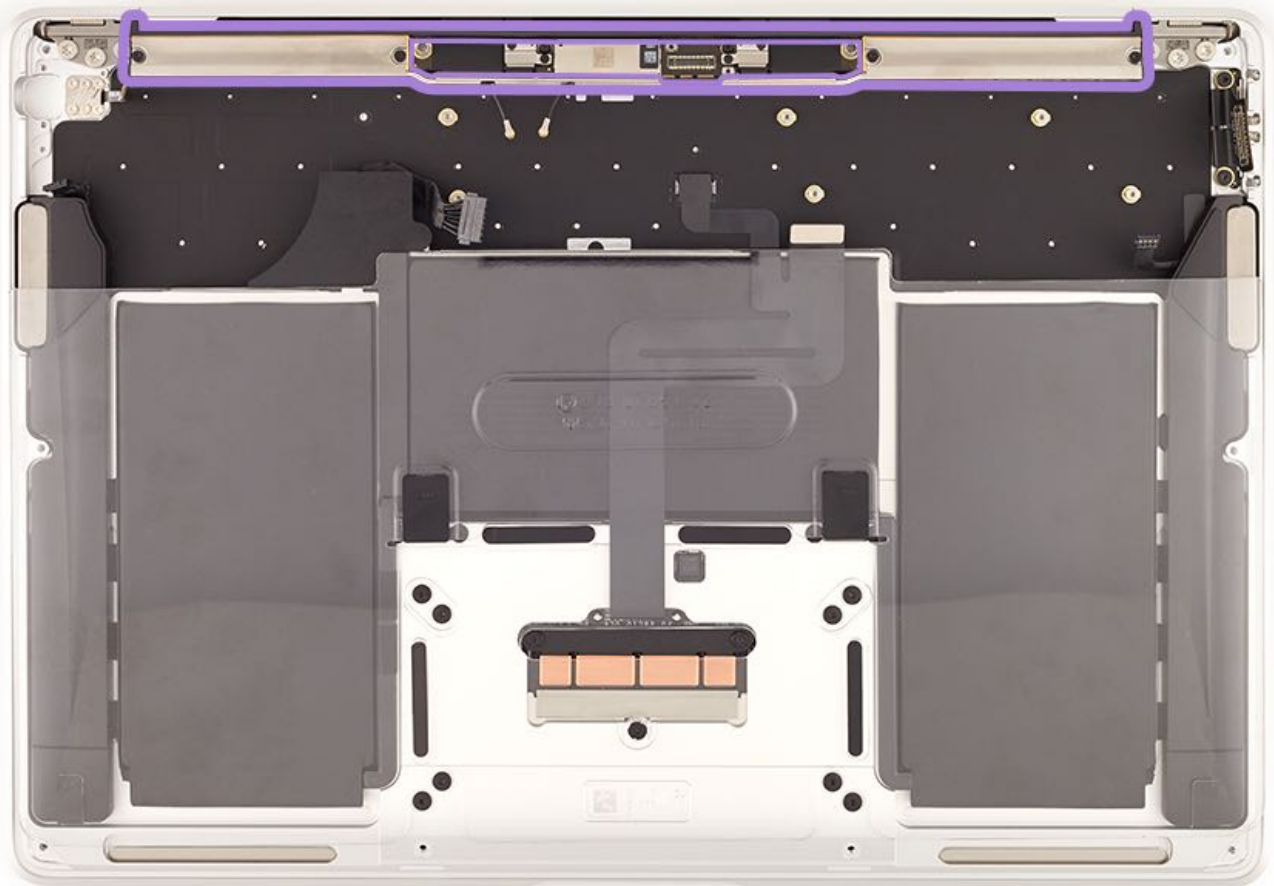
Important:

- Only Apple-certified technicians should perform this procedure. For more information, refer to [OP1859: About Apple service certifications](#).
- Wear an ESD wrist strap and take precautions to avoid ESD.

Remove:

- [Bottom Case](#)
- [Logic Board](#)
- [Audio Board Flex Cable](#)
- [Audio Board](#)
- [Fan](#)

For video instruction, refer to [SV392: Vent/Antenna Module Replacement Video](#).



Tools

1. Torx T5 screwdriver, magnetized
2. Black stick
3. Antenna tool



Steps For Removal



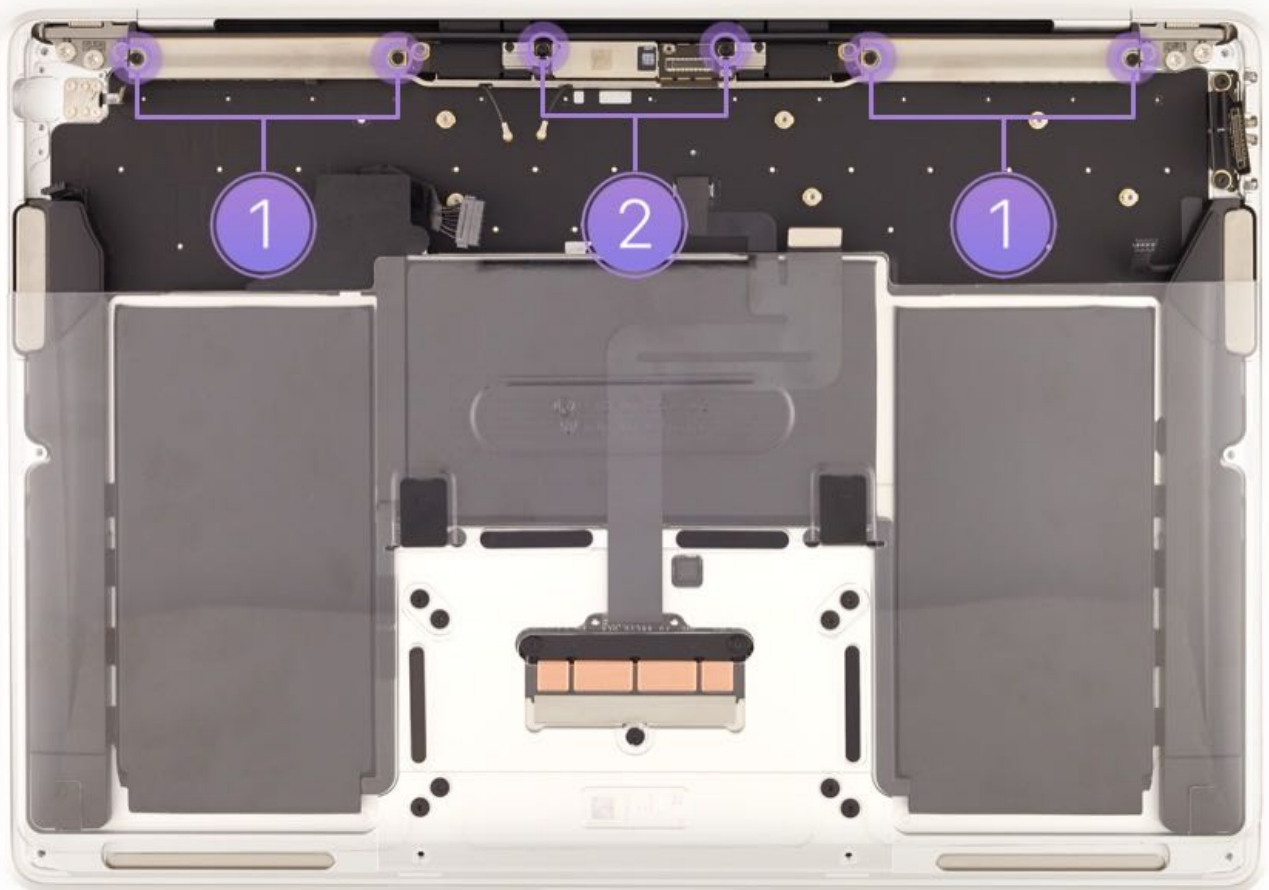
Caution: The vent/antenna module is fragile. Be careful not to bend it.

1. Remove the four T5 screws from the vent/antenna module and two T5 screws from the TCON.

- T5: 923-02900 (4) (position 1)



- T5: 923-02925 (2) (position 2)



2. Slightly tilt the vent/antenna module back and slide the black stick underneath. Slowly slide the black stick to the side to unclip the teeth. You should hear an audible click.



3. Repeat the same motion on the left side of the vent/antenna module.



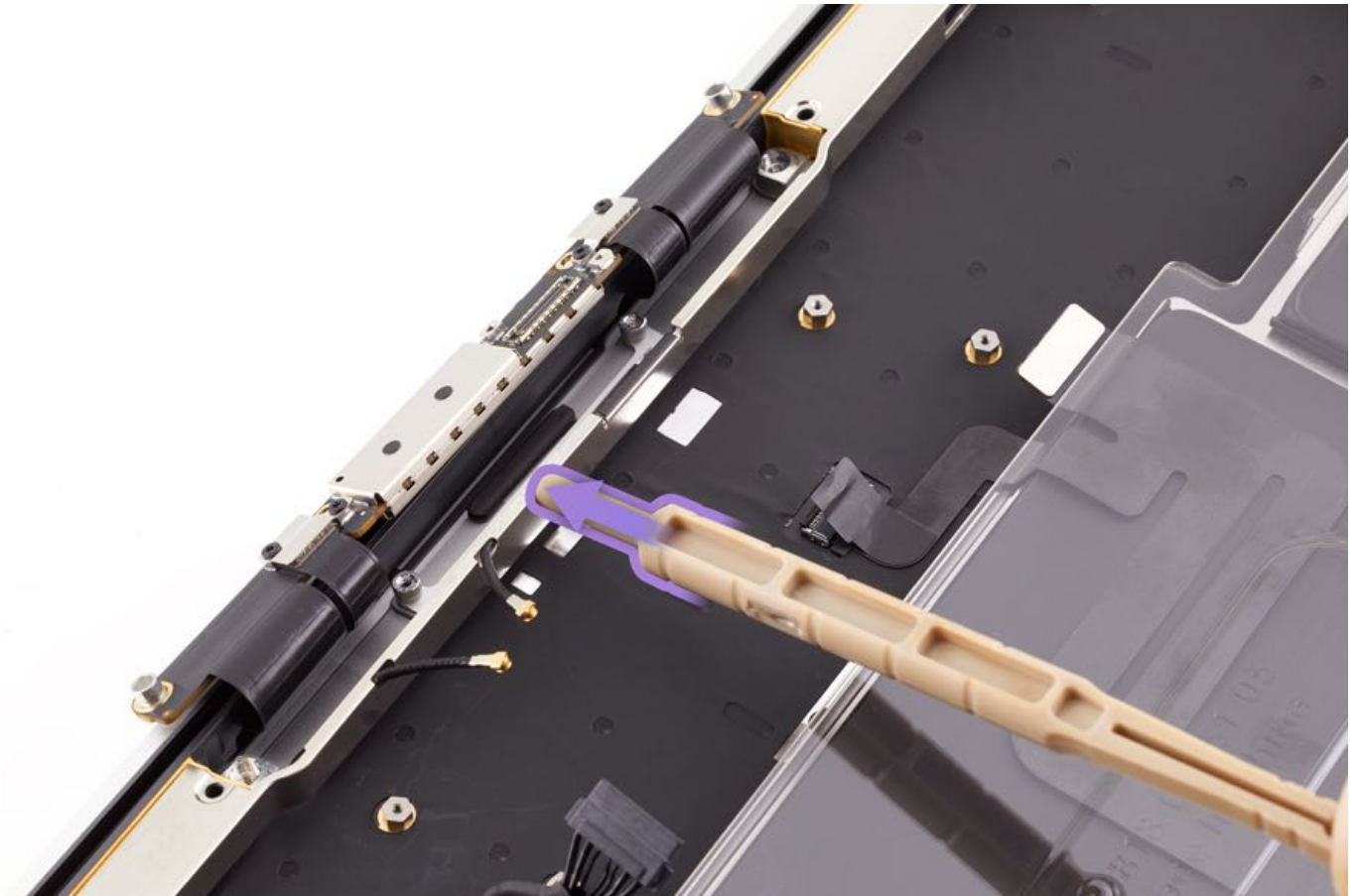
4. Insert the black stick underneath the clip of the vent/antenna near the screw boss to unclip the middle teeth. Once the teeth are unclipped, lift out the vent/antenna module.

Note: If the teeth do not unclip on the first try, insert the black stick a little further under the vent/antenna module.



Steps For Reassembly

1. Thread the TCON through the opening in the metal case of the vent/antenna module. Using the blunt end of the antenna tool, push the vent/antenna module in at the middle until the tabs are fully inserted and it feels like it locks in place.



2. Gently wiggle the vent/antenna module to check that it is in place.

3. Reinstall the six T5 screws.
4. Reassemble in reverse order of removal.

- [Fan](#)
- [Audio Board](#)
- [Audio Board Flex Cable](#)
- [Logic Board](#)
- [Bottom Case](#)



5. **Caution:** This repair is not complete until the System Configuration has been performed. For instructions, refer to [TP1657: System Configuration for Macs with the Apple T2 Security Chip](#). Failure to perform this step will result in an inoperative system and an incomplete repair.
6. After System Configuration is performed, verify the trackpad performance with Trackpad Calibration Check. For instructions on trackpad calibration, refer to [TP1314: Trackpad Calibration Check](#).

Right and Left Speakers

First Steps



Warning:

- Attach the battery cover and disconnect the battery immediately after removing the bottom case.
- Do not apply external power while the computer is under repair.

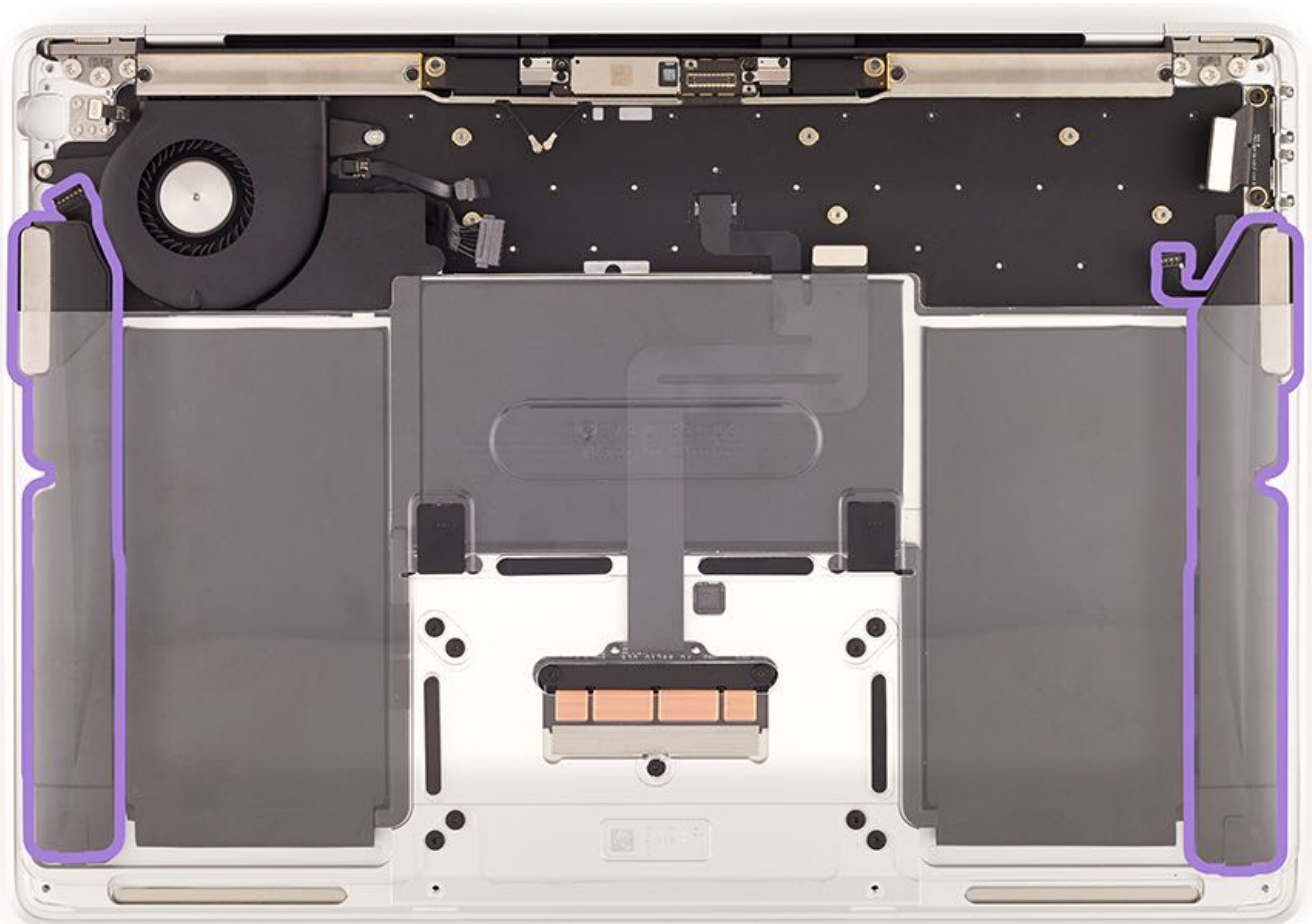
Important:

- Only Apple-certified technicians should perform this procedure. For more information, refer to [OP1859: About Apple service certifications](#).
- Wear an ESD wrist strap and take precautions to avoid ESD.

Remove:

- [Bottom Case](#)
- [Logic Board](#)
- [Audio Board Flex Cable](#)
- [Audio Board](#)

For video instruction, refer to [SV395: Speaker Replacement Video](#).



Tools

1. Speaker adhesive (076-00411)
Note: Battery adhesive is included in the kit.
2. Black stick
3. ESD-safe flat-nosed tweezers



Steps For Removal

1. Lift the battery cover up slightly to reach the speaker adhesive pull tab. Be sure the battery cover clips remain in place.



2. Grasp the bottom pull tab with a flat-nosed, ESD-safe tweezer.



3. Extend the adhesive strip past the battery cover and twist the tweezers to wrap the speaker adhesive tab around it. As the speaker adhesive strip extends, continue to twist and slowly pull it with the tweezers.

Important: Avoid pulling the adhesive strip against the edge of the speaker well or the strip may break.



4. Repeat the process with the speaker adhesive tab at the top of the speaker.



Note: If an adhesive strip breaks, then attempt to retrieve the rest of the strip with ESD-safe tweezers. If the rest of the strip cannot be retrieved, then attempt to remove the other adhesive strip.

6. Lift the speaker out of the top case.



Steps For Reassembly

Important:

- Speakers must be replaced as a pair.
- If installing replacement speakers, the PSA will be preinstalled.
- If reinstalling the original speakers, you will have to adhere the PSA to the back of each speaker.
- Check the speaker well for adhesive. Clean the area with an IPA wipe only if there is adhesive residue present.

Note:

- If installing new speakers, peel the backing off of the PSA that is preapplied to the back of the speaker.



- If reinstalling speakers, remove the backing from the included PSA strips.



1. Rotate the speaker slightly and tuck it into position in the top case, and gently press down on both ends of the speaker for a few seconds to adhere the speaker to the top case.



2. Fold the pull tab back onto the bottom of speaker.



3. Reinstall the [logic board](#).

4. Reinstall the [audio board](#).

5. Reinstall the [audio board flex cable](#).

6. Reinstall the [bottom case](#).

7. **Caution:** This repair is not complete until the System Configuration has been performed. For instructions, refer to [TP1657: System Configuration for Macs with the Apple T2 Security Chip](#). Failure to perform this step will result in an inoperative system and an incomplete repair.

8. After System Configuration is performed, verify the trackpad performance with Trackpad Calibration Check. For instructions on trackpad calibration, refer to [TP1314: Trackpad Calibration Check](#).

Battery

First Steps



Warning:

- Attach the battery cover and disconnect the battery immediately after removing the bottom case.
- Do not apply external power while the computer is under repair.

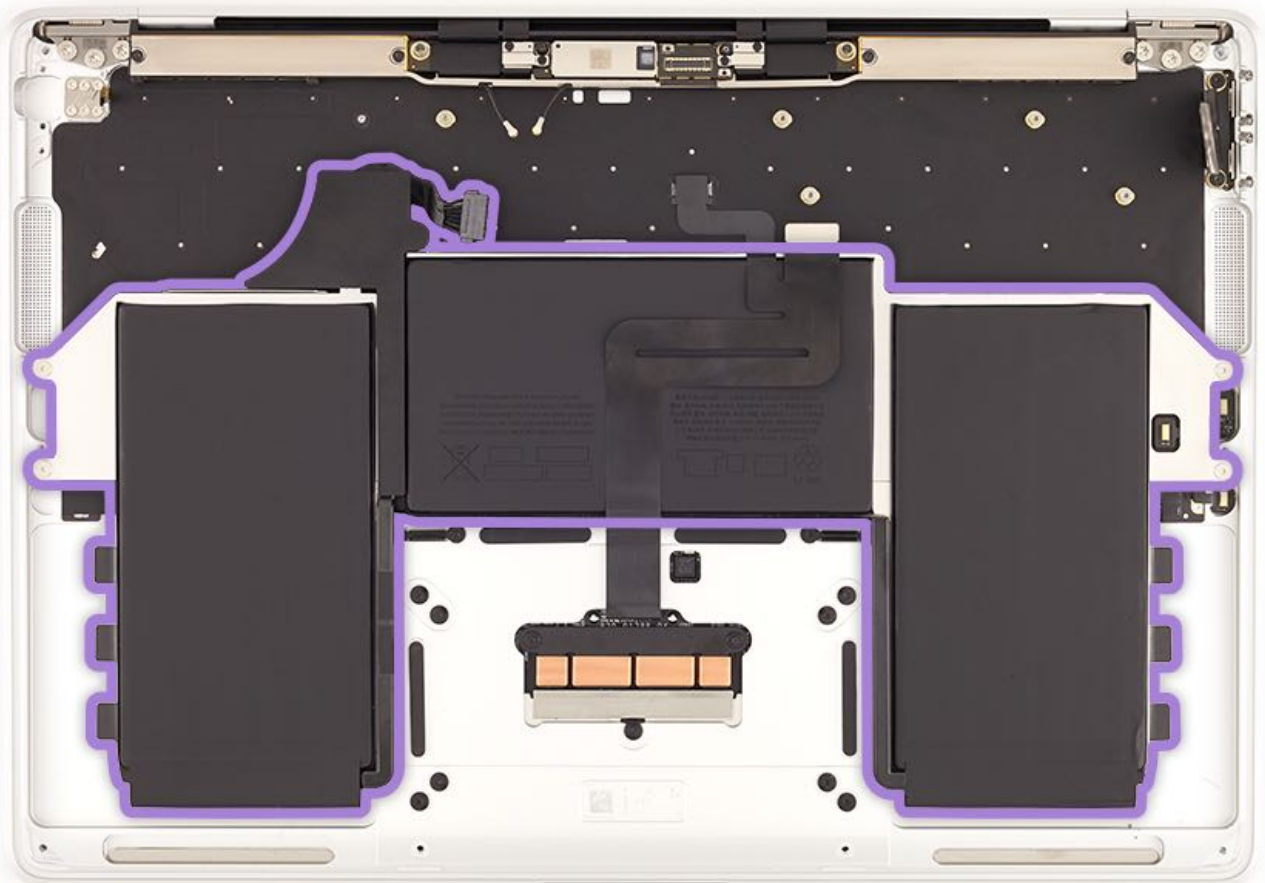
Important:

- Only Apple-certified technicians should perform this procedure. For more information, refer to [OP1859: About Apple service certifications](#).
- Wear an ESD wrist strap and take precautions to avoid ESD.

Remove:

- [Bottom Case](#)
- [Logic Board](#)
- [Speakers](#)

For video instruction, refer to [SV390: Battery Replacement Video](#).



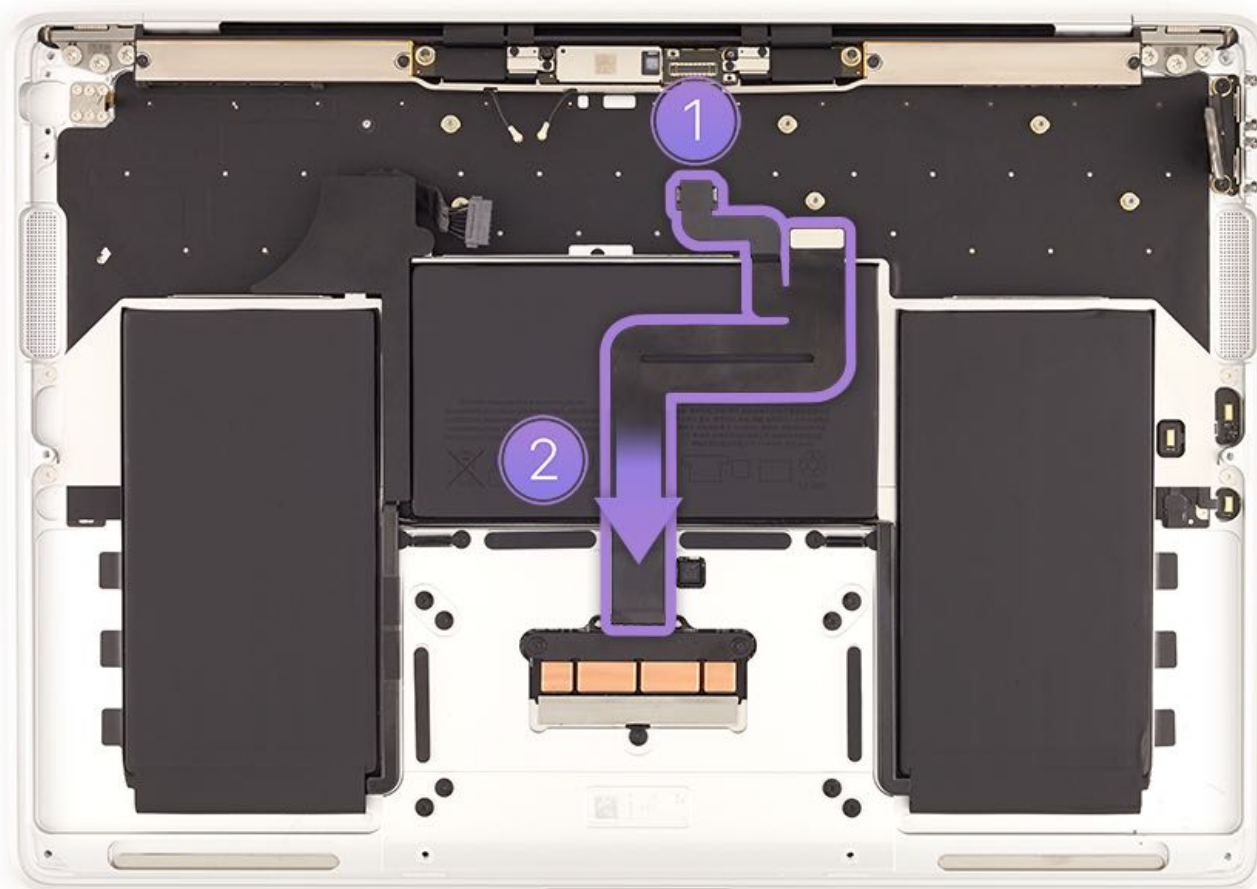
Tools

1. Battery adhesive (076-00411)
Note: Speaker adhesive is included in the kit.
2. iPhone Display Press (661-08916)
3. Battery press plate and support frame (923-03007)
4. Flat-nosed ESD-safe tweezers
5. T3 driver
6. Guide pins

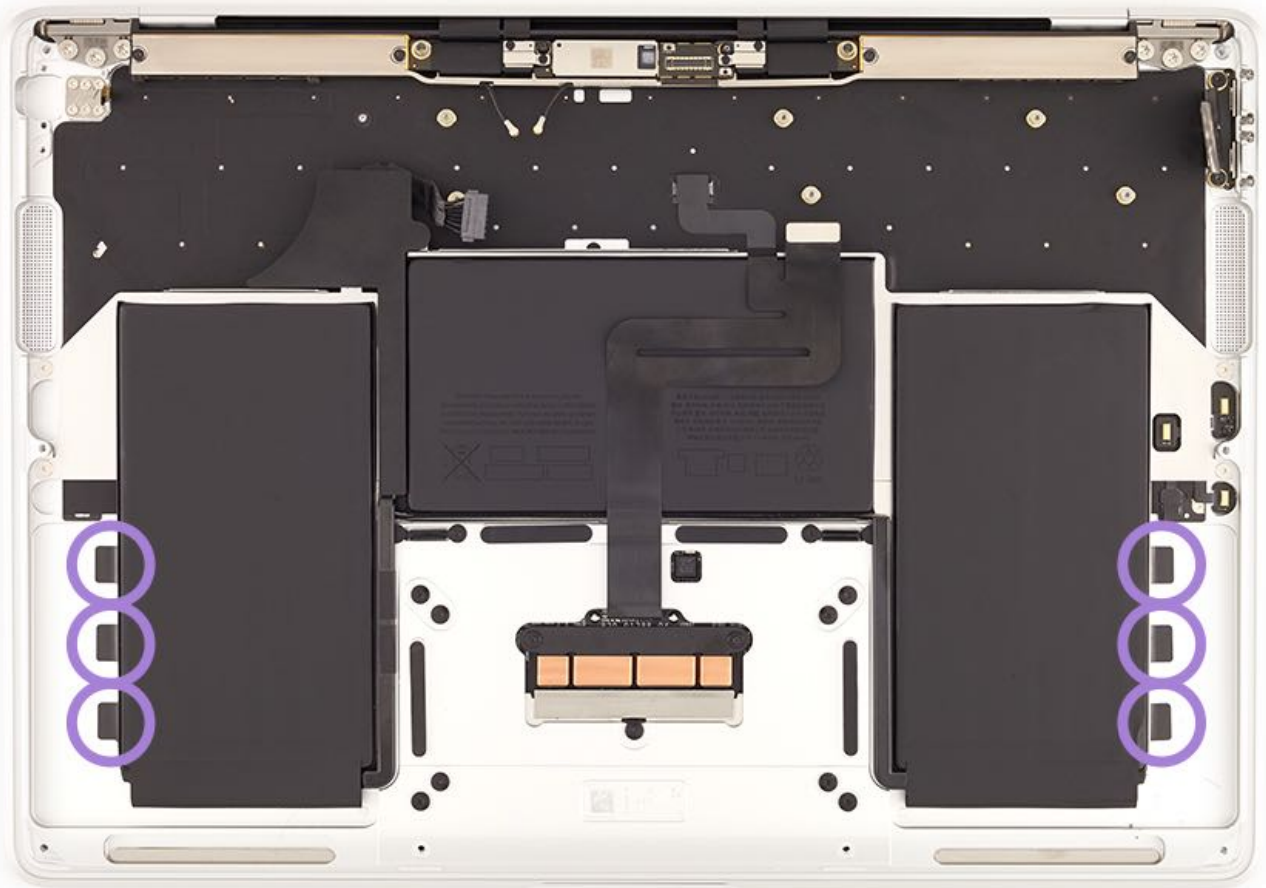


Steps For Removal

1. Disconnect the IPD flex cable from the top case (1) and gently loosen the adhesive attaching the flex to the battery (2).



2. Locate the battery tabs on each side of the battery.



3. Put the battery cover on and lift up to allow space to reach the battery tab.



4. Grasp the tab with ESD-safe, flat-nosed tweezers.



5. Gently pull the tab towards you and once it clears the battery cover, begin to slowly twirl the adhesive around the tweezer. Continue this process until the adhesive is removed from underneath the battery. Repeat this procedure for all six tabs.

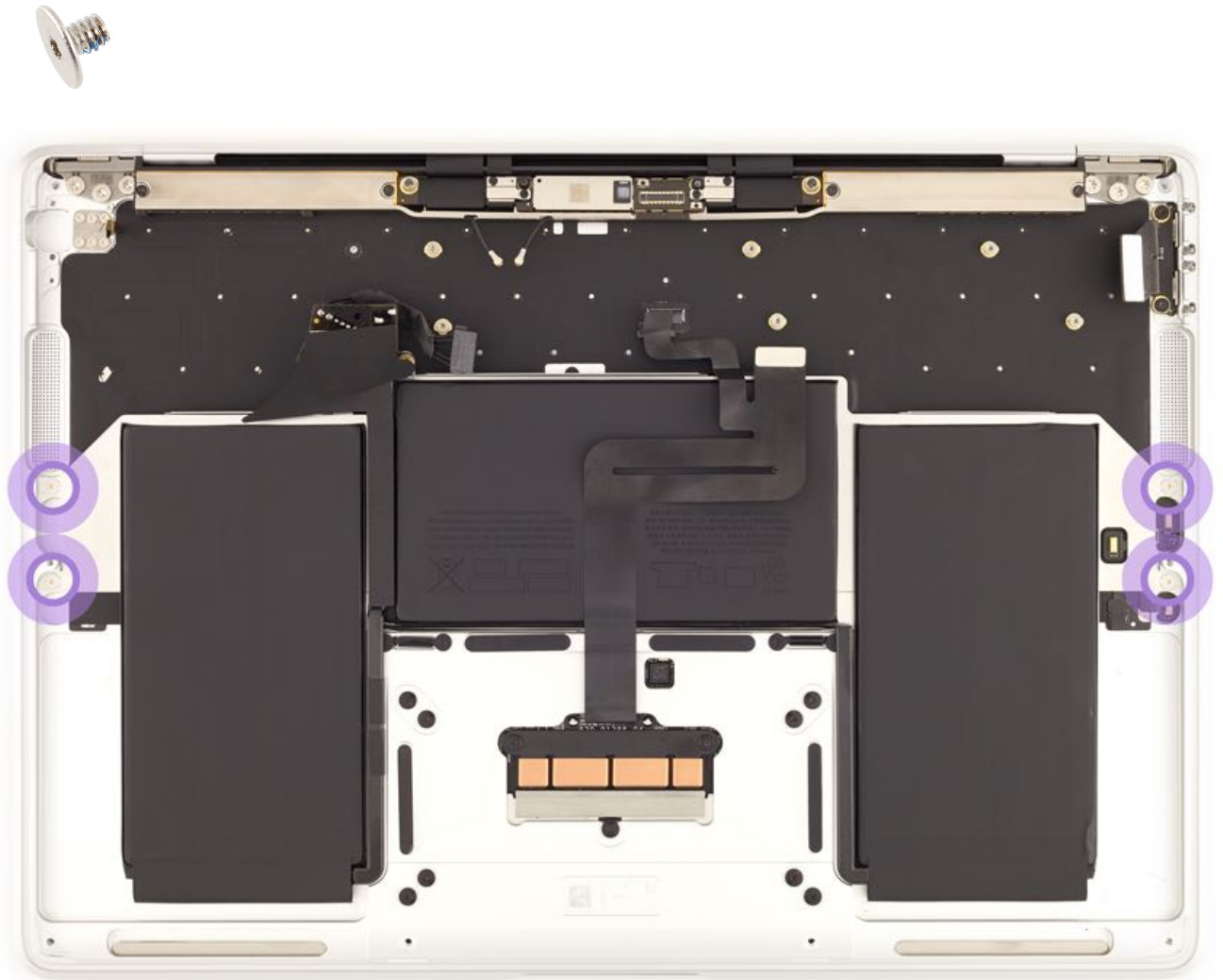


Caution: This procedure requires slow, steady movements. Take your time. Pulling the adhesive too quickly can cause the adhesive to break, resulting in a more difficult repair or a whole top case replacement.



6. Remove the four T3 screws from the battery.

- T3: 923-02924

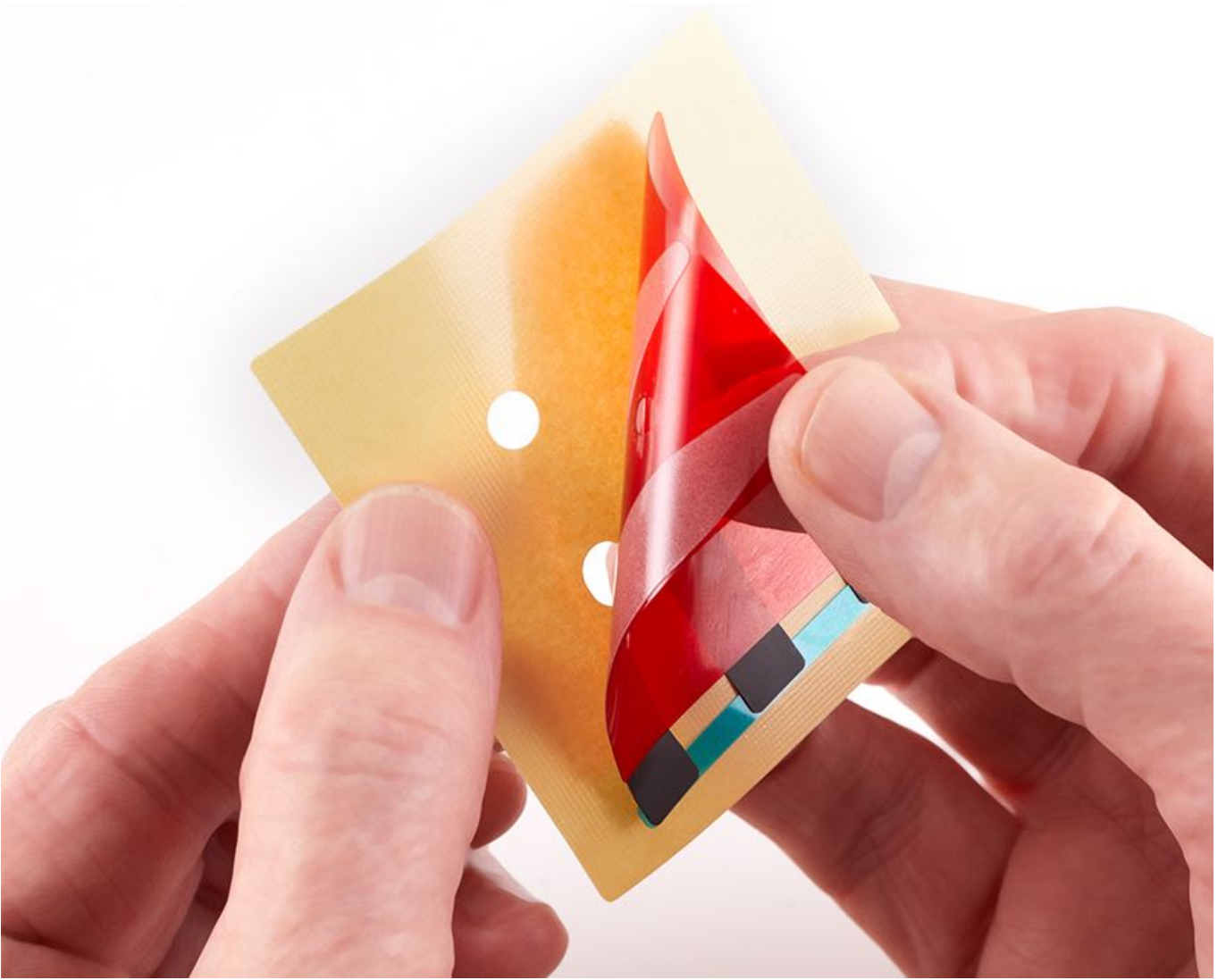


7. Remove the battery cover. Grasp the battery at the corners and lift out of the top case. **Caution:** The battery sits on a metal tray that is part of the battery assembly. Do not attempt to remove the battery from the tray.



Steps For Reassembly

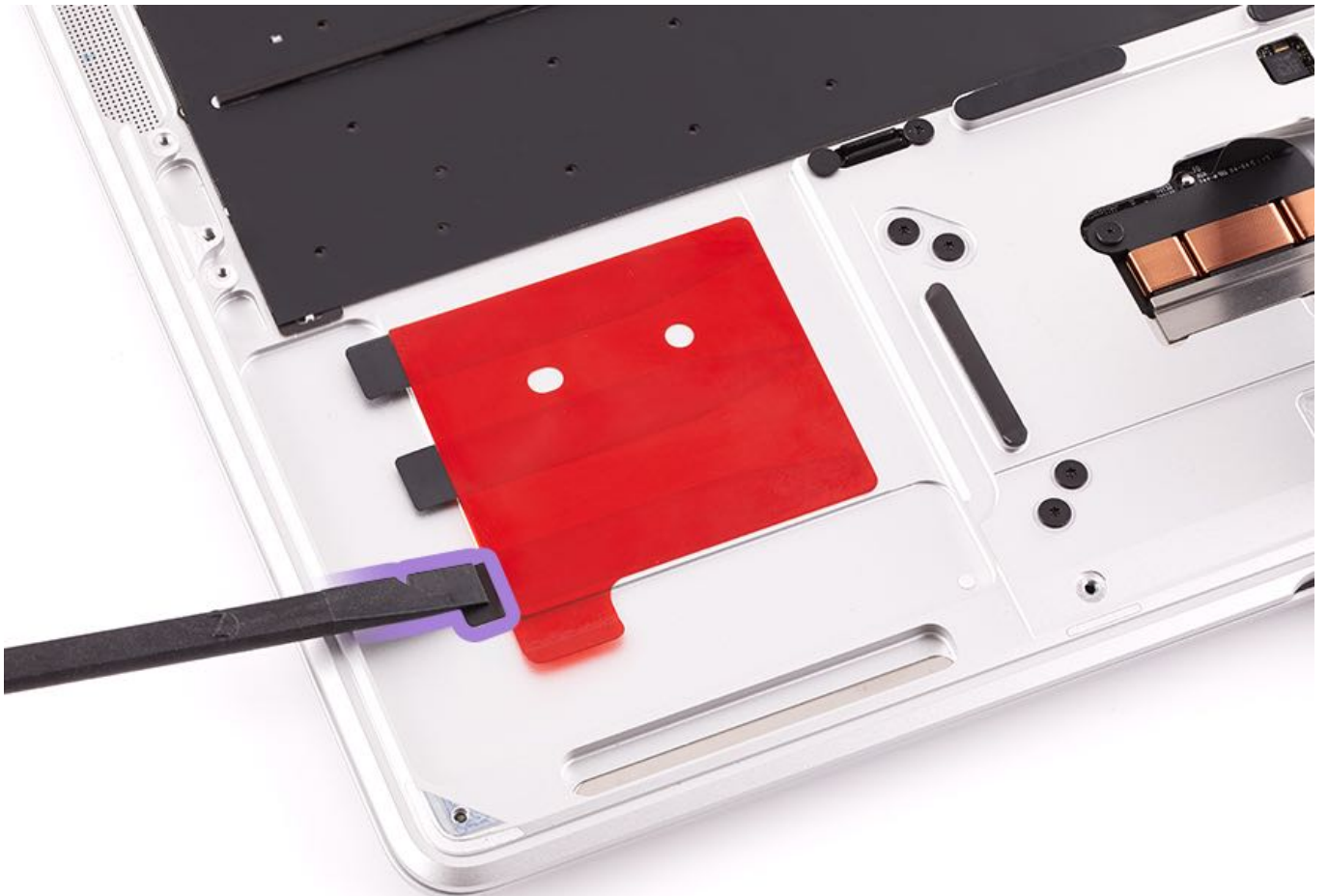
1. Check the battery well for adhesive residue. Clean the area with an IPA wipe only if there is adhesive residue present.
2. Remove the square backing from the battery adhesive.



3. Align the adhesive strips on each side of the top case as shown in the image below. **Note:** Put adhesive in the top case, not on the back of the battery.



4. Remove the blue film and press all six tabs down.

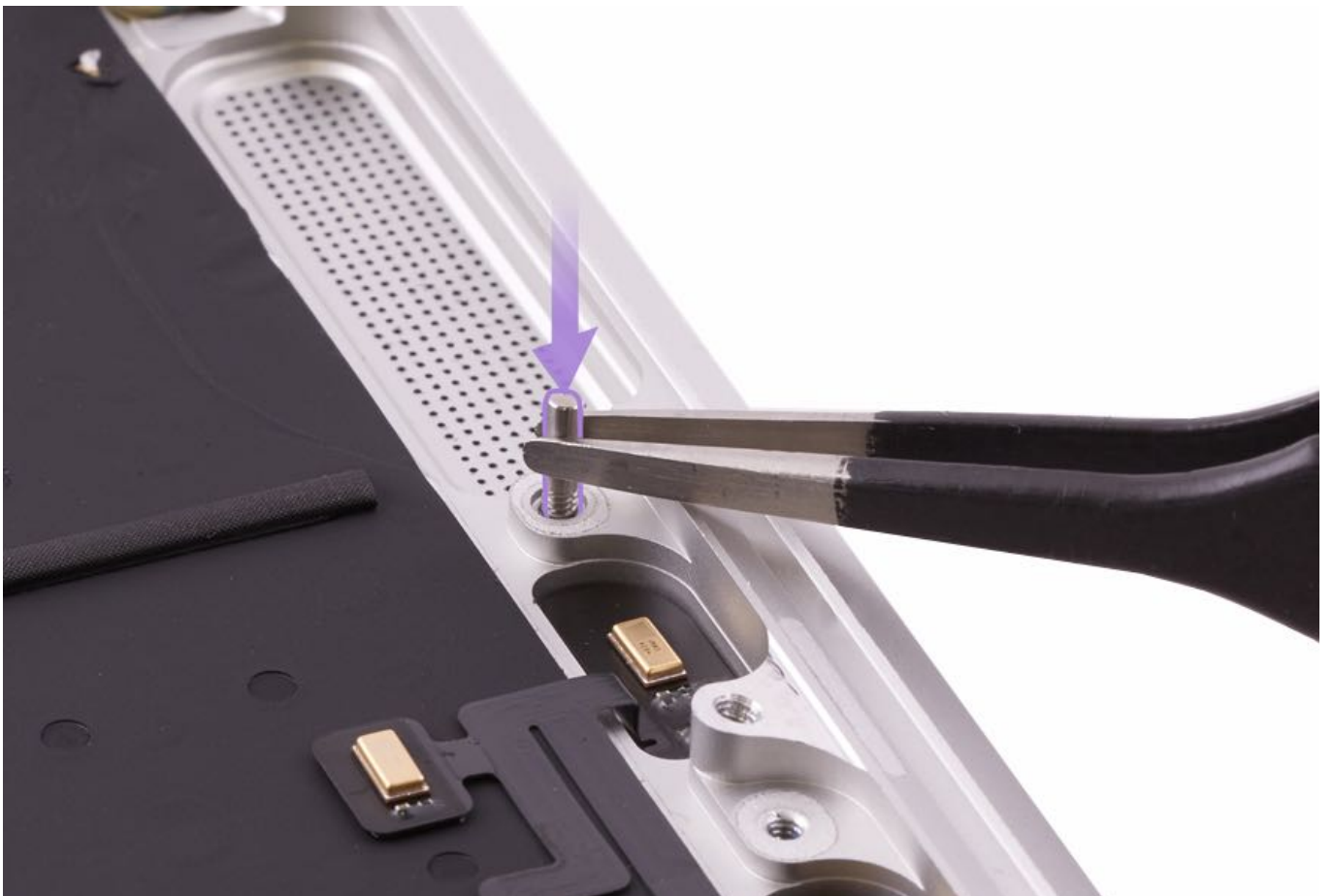


5. With your hands or a microfiber cloth, smooth down the red film to remove any air bubbles and to adhere the adhesive to

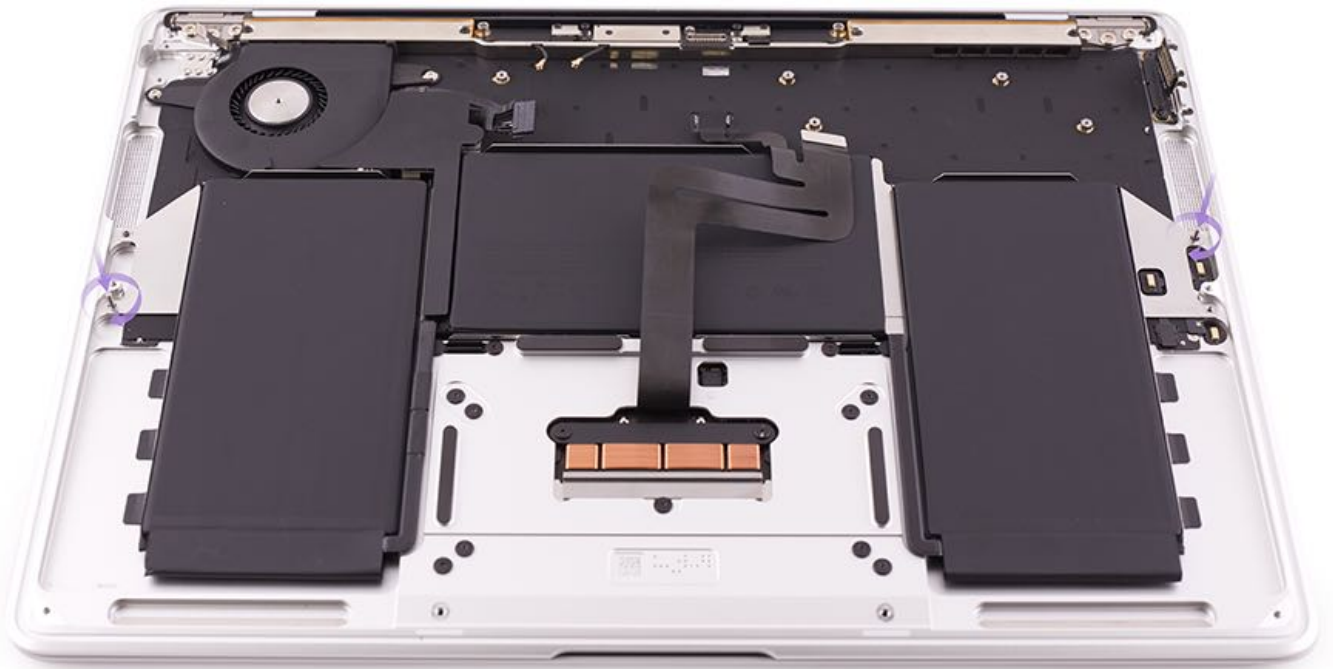
the top case. Remove the red film.



6. Use tweezers to place the threaded end of two guide pins in two of the four top case screw holes.



7. Turn the guide pins clockwise to screw them in.



8. Align the screw holes on the metal tray over the guide pins and lower the battery.



9. Remove the guide pins.

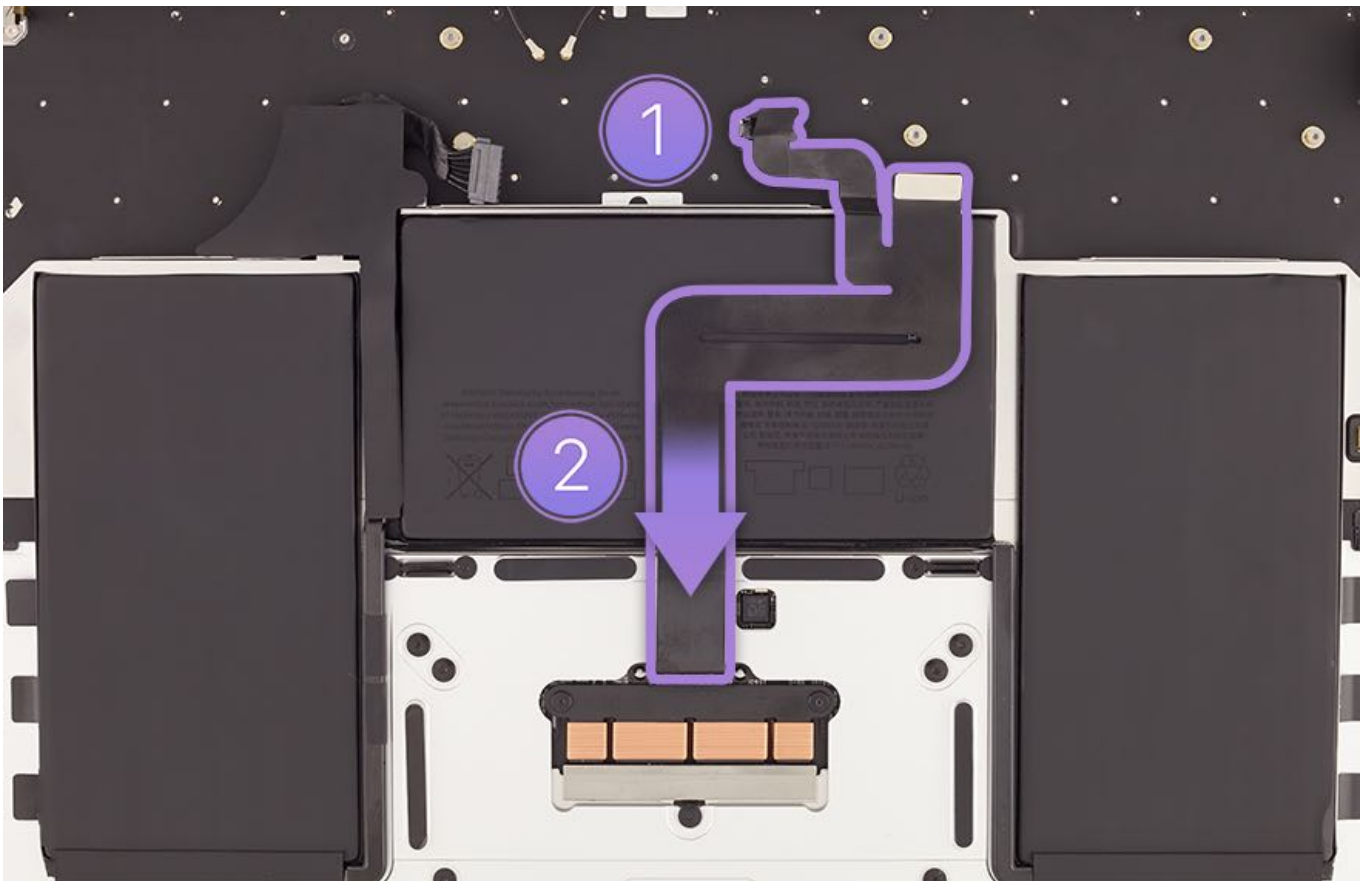


10. Reinstall the battery screws.

- T3: 923-02924



11. Reconnect the IPD flex cable (1) and gently adhere the adhesive to the battery (2).

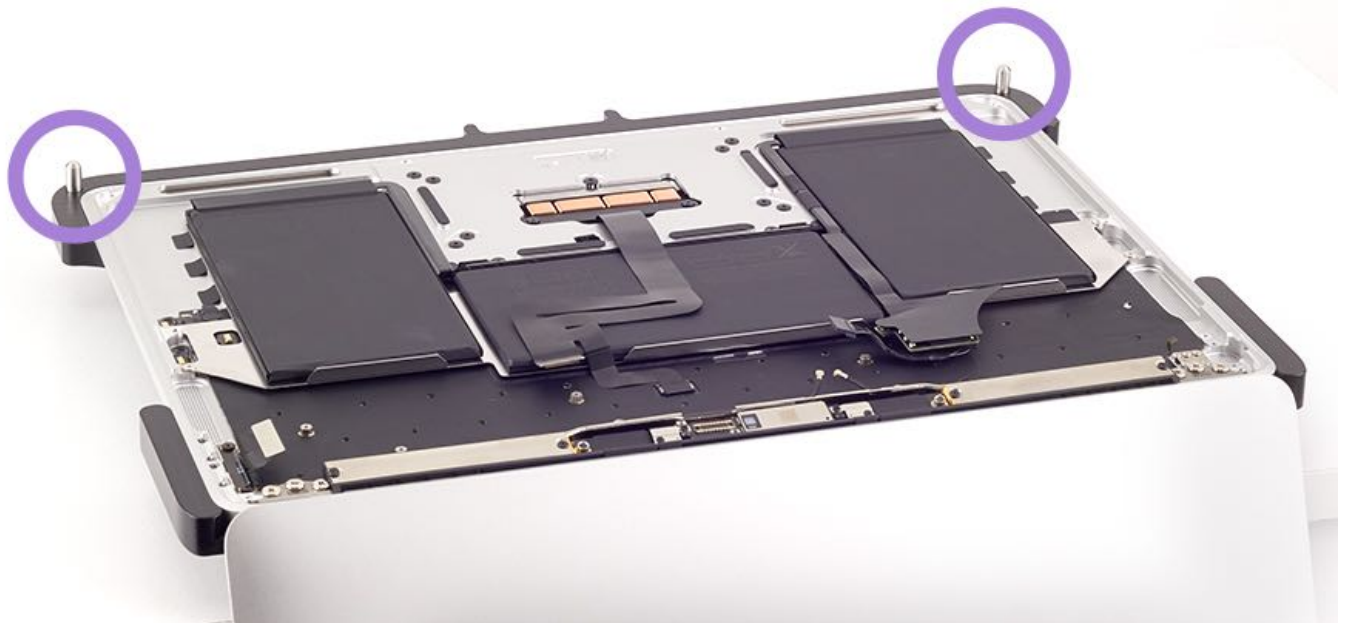


12. Place the computer in the support frame with the display hanging over the edge of the repair bench. Be sure the display is not touching the table edge to avoid scratching the display.

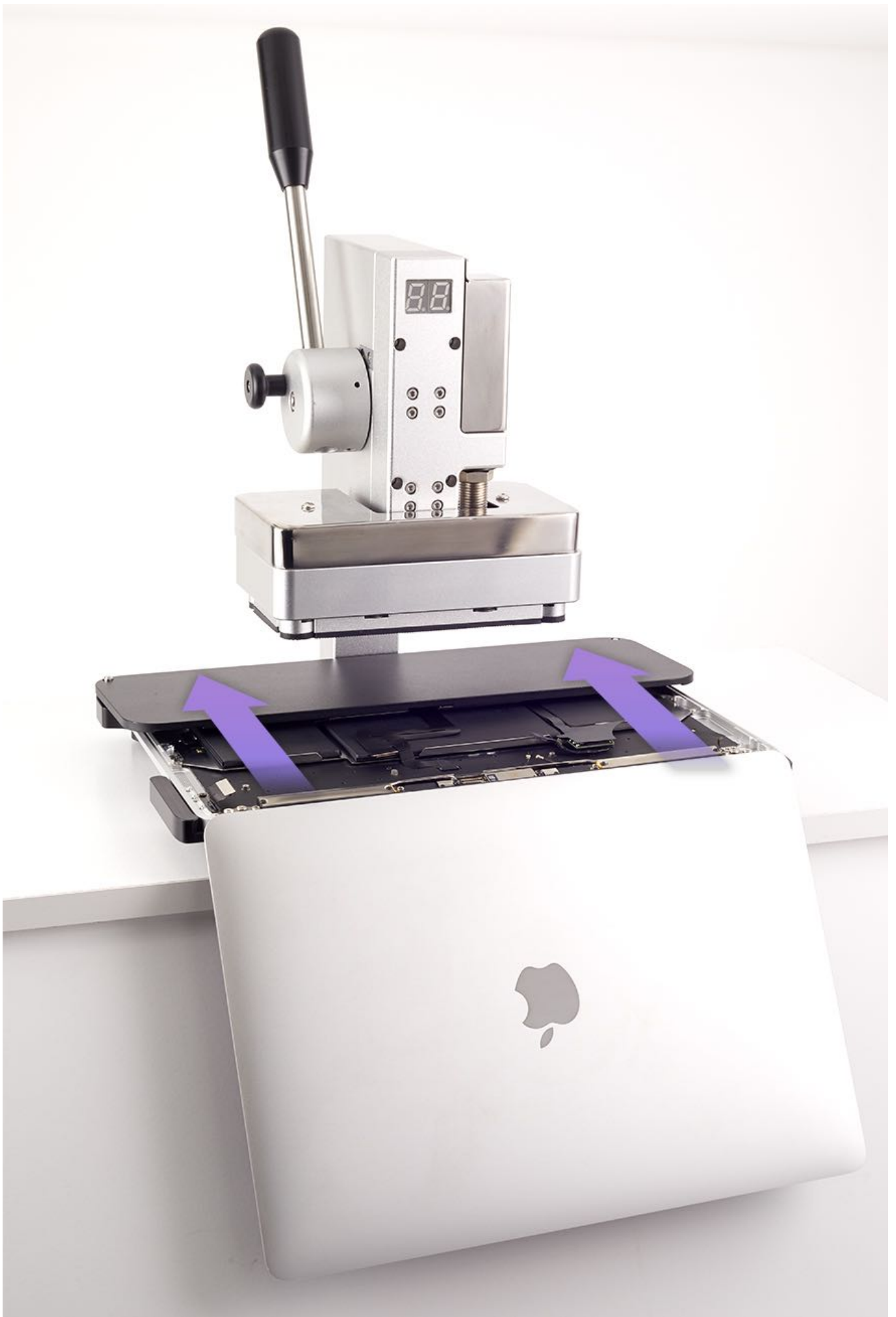


13. Line up the metal pins on the support frame with the holes on the press plate and place the press plate on top of the

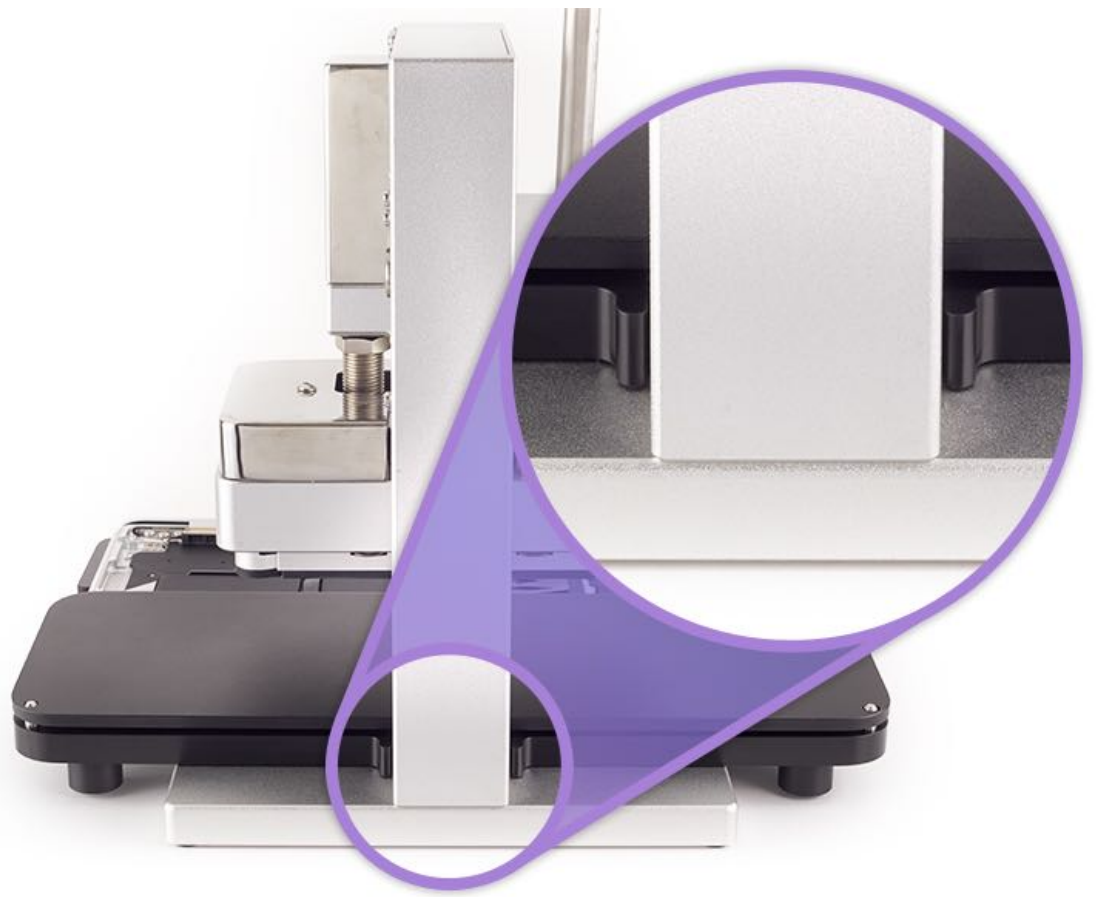
battery.



14. Place the support frame with the press plate in place into the display press.



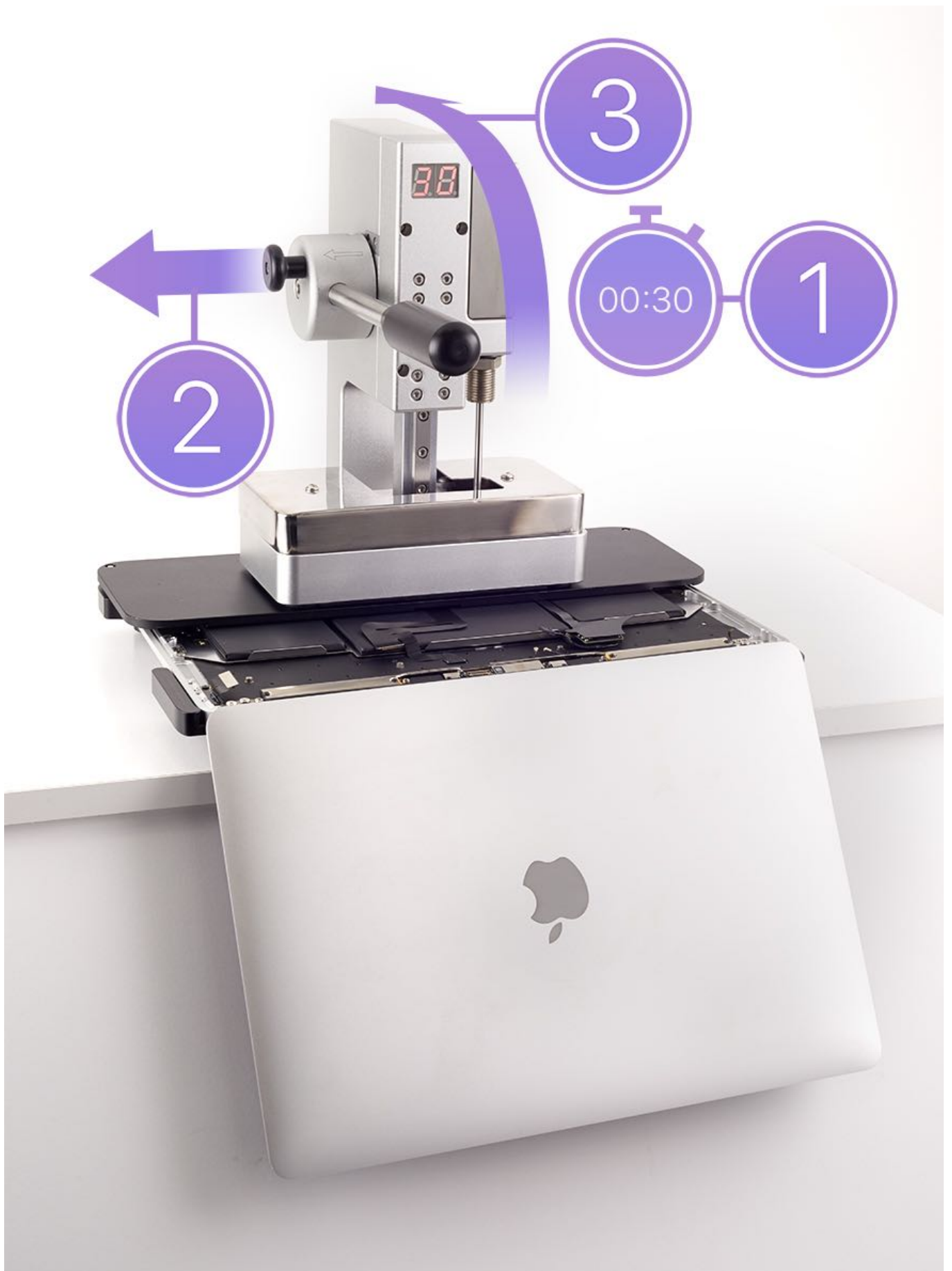
15. Check the back of the display press to make sure the support frame is aligned correctly.



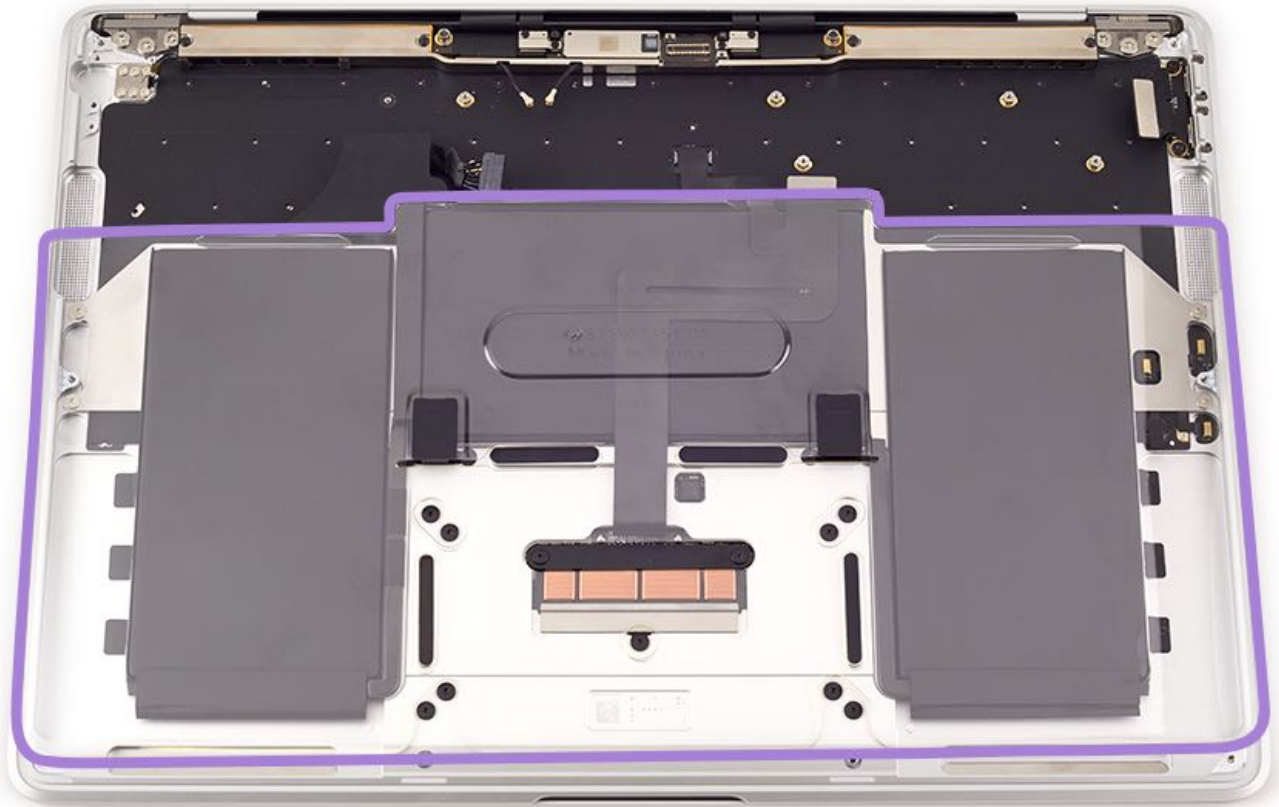
16. Pull down the lever until it locks.



17. The press will automatically count down 30 seconds (1). To release the lever, lower it slightly and pull the knob to unlock (2). Lift the lever (3).



18. Remove the support tray from the press and lift off the press plate. Attach the battery cover to continue the reassembly.



19. Reinstall the [speakers](#). **Note:** Replacement speaker adhesive is included with a replacement battery. Speaker adhesive will have to be applied to the back of the speakers.

20. Reinstall the [logic board](#).

21. Reinstall the [bottom case](#).



22. **Caution:** This repair is not complete until the System Configuration has been performed. For instructions, refer to [TP1657: System Configuration for Macs with Apple T2 Security Chip](#). Failure to perform this step will result in an inoperative system and an incomplete repair.

23. After System Configuration is performed, verify the trackpad performance with Trackpad Calibration Check. For instructions on trackpad calibration, refer to [TP1314: Trackpad Calibration Check](#).

Input/Output (I/O) Board

First Steps



Warning:

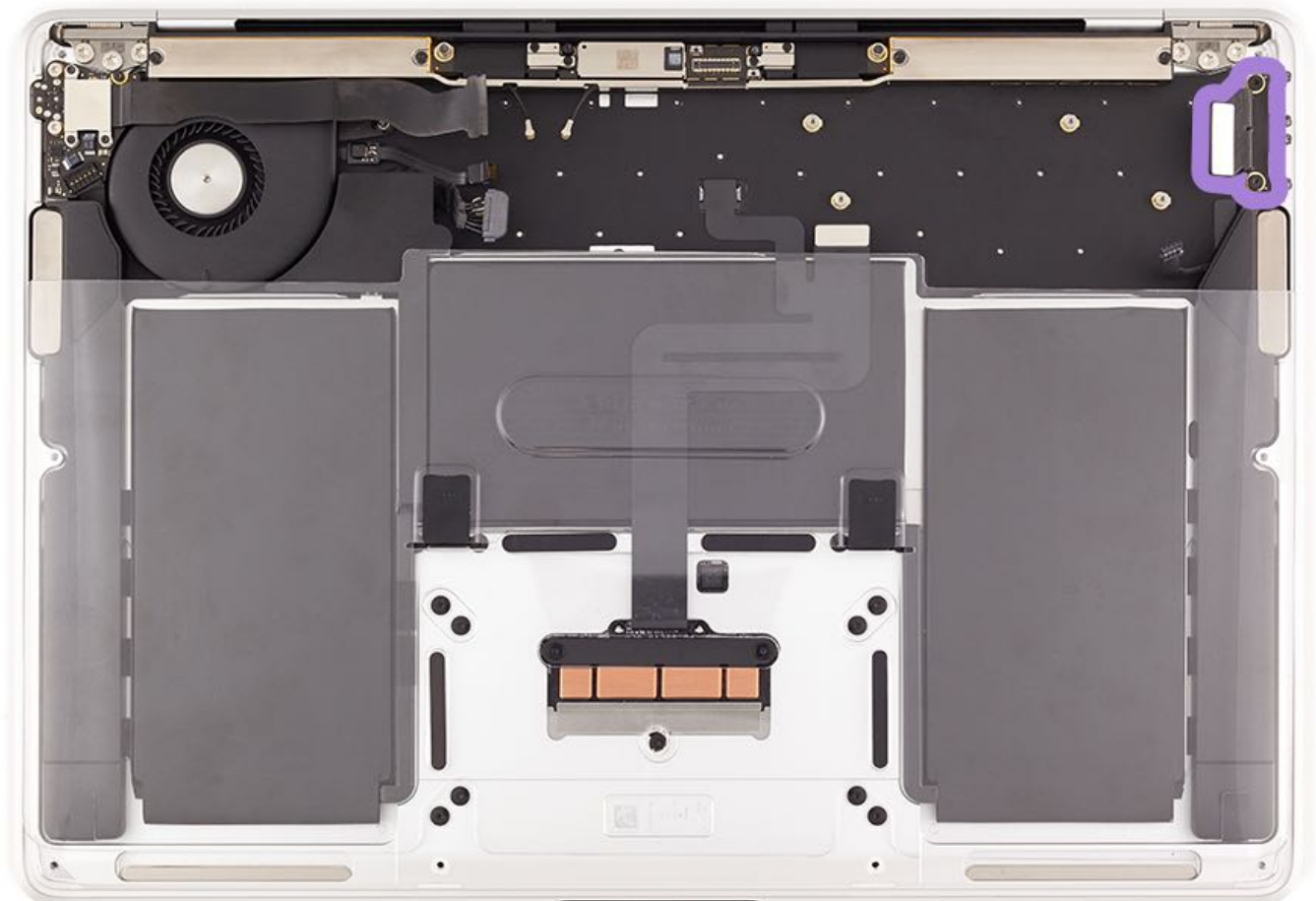
- Attach the battery cover and disconnect the battery immediately after removing the bottom case.
- Do not apply external power while the computer is under repair.

Important:

- Only Apple-certified technicians should perform this procedure. For more information, refer to [OP1859: About Apple service certifications](#).
- Wear an ESD wrist strap and take precautions to avoid ESD.

Remove:

- [Bottom Case](#)
- [Logic Board](#)



Tools

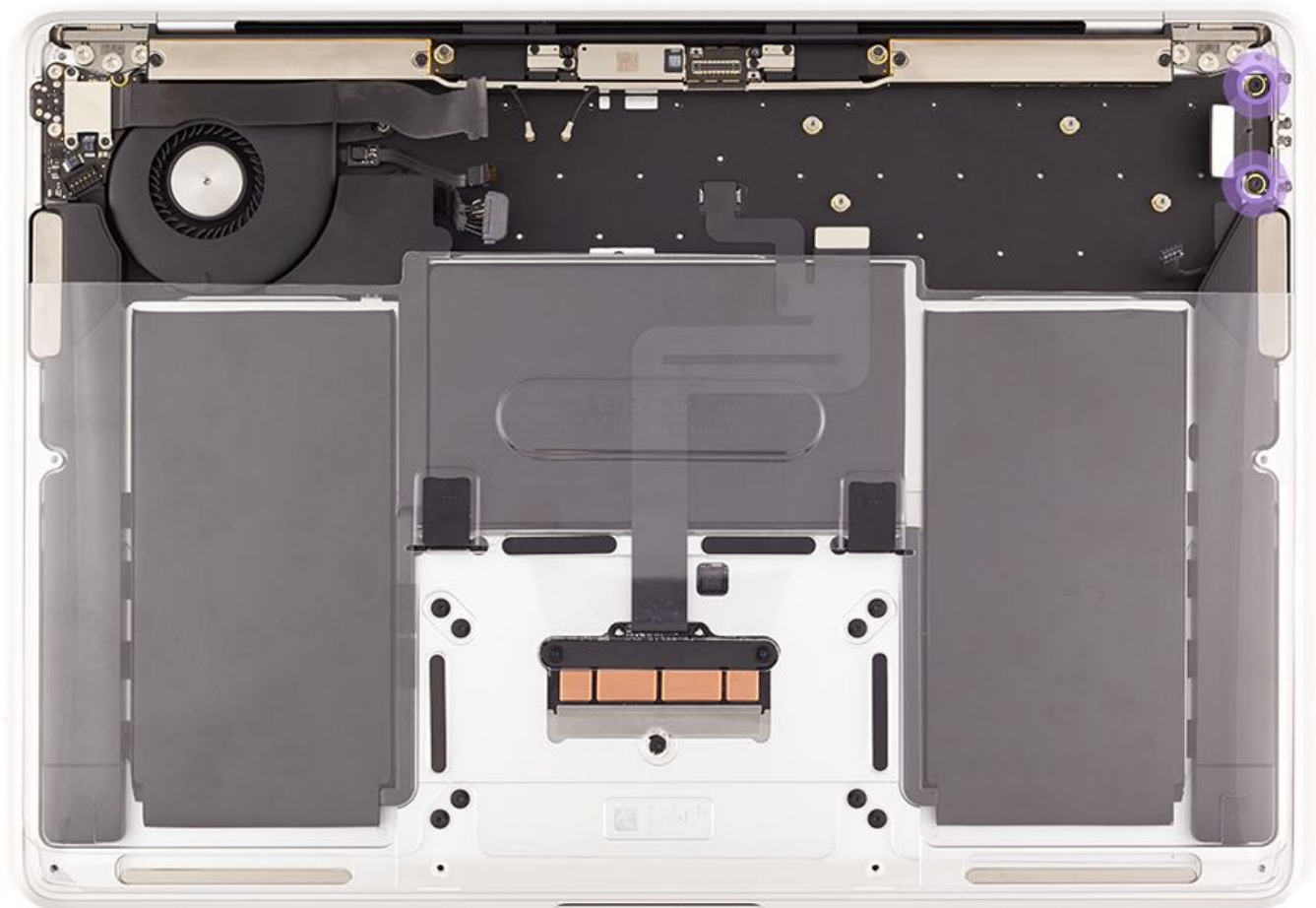
1. Torx T3 screwdriver (magnetized)
2. Black stick



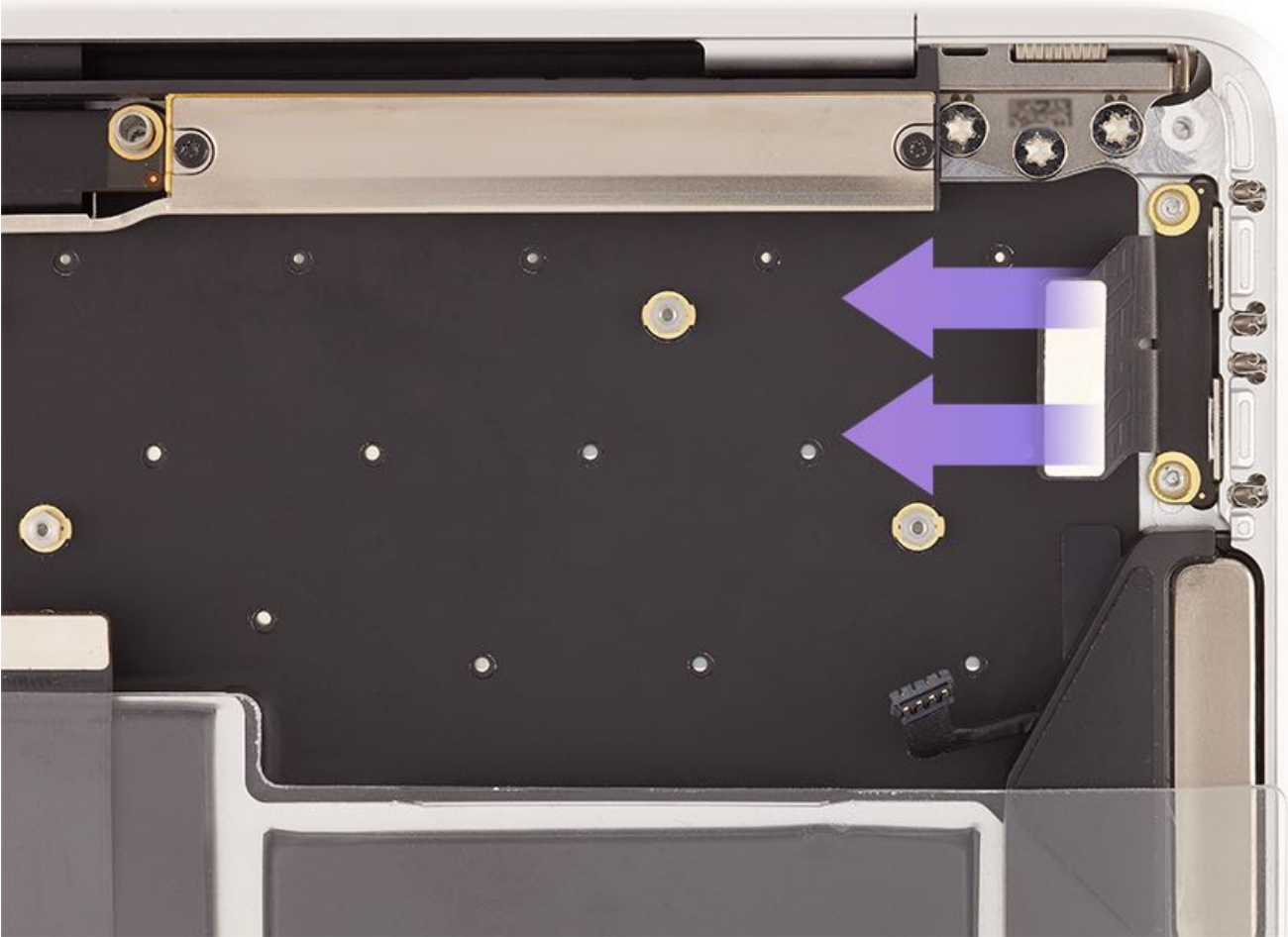
Steps For Removal

1. Remove two T3 screws for the I/O board.

- T3: 923-02889

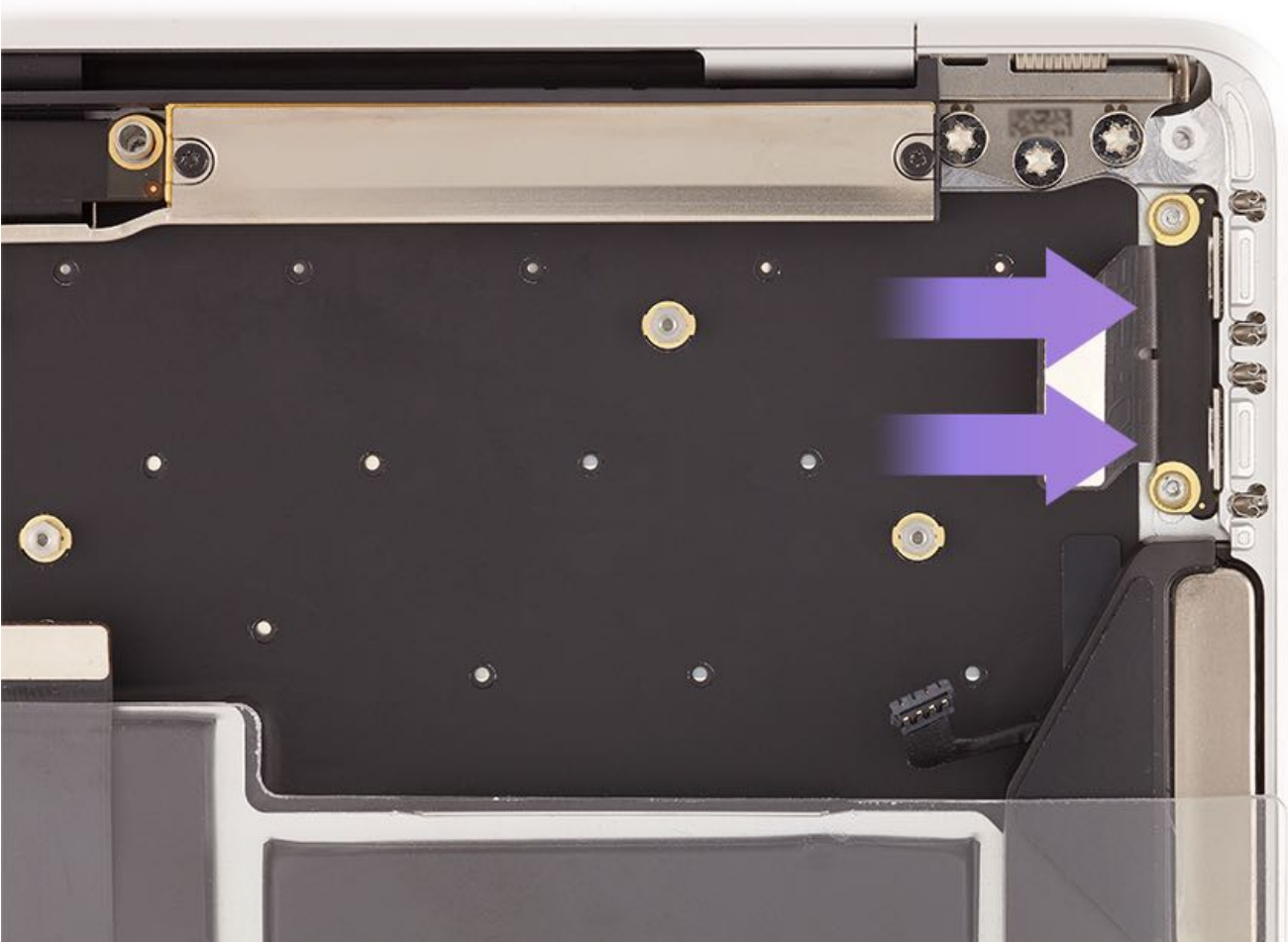


2. Grasp the board by the sides and gently slide it out of the ports.



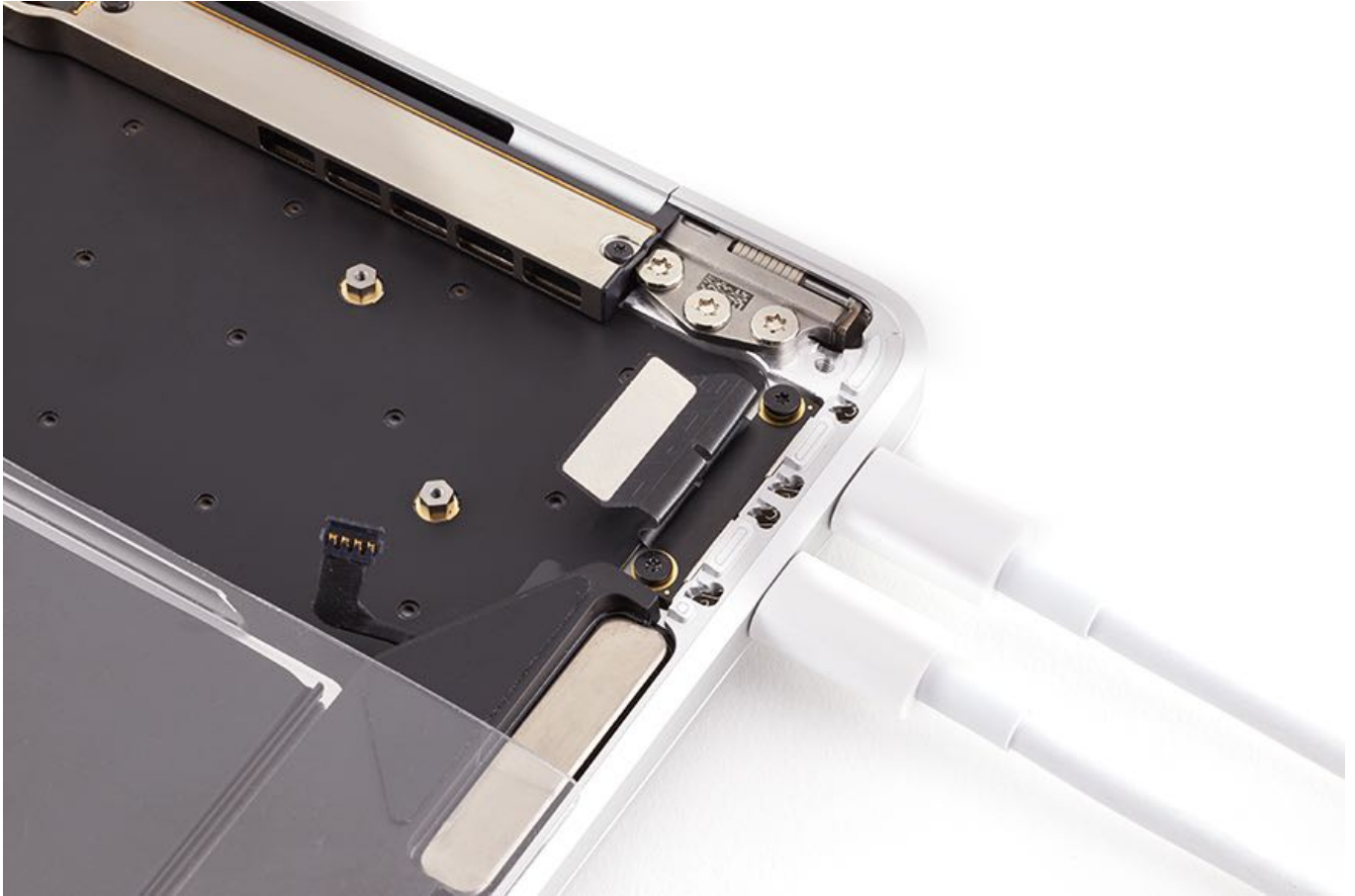
Steps For Reassembly

1. Place the I/O board into position in the top case.



2. Reinstall the two T3 screws and lightly torque them down.
3. Plug an external USB-C charging cable into both ports to check the alignment.

Warning: The charging cable should **not** be plugged into power.



4. Keep the the charging cable in the ports and torque the screws all the way down.
5. Remove the charging cable.
6. Reinstall the [logic board](#).
7. Reinstall the [bottom case](#).



8. **Caution:** This repair is not complete until the System Configuration has been performed. For instructions, refer to [TP1657: System Configuration for Macs with the Apple T2 Security Chip](#). Failure to perform this step will result in an inoperative system and an incomplete repair.

9. After System Configuration is performed, verify the trackpad performance with Trackpad Calibration Check. For instructions on trackpad calibration, refer to [TP1314: Trackpad Calibration Check](#).

Audio Board Flex Cable

First Steps



Warning:

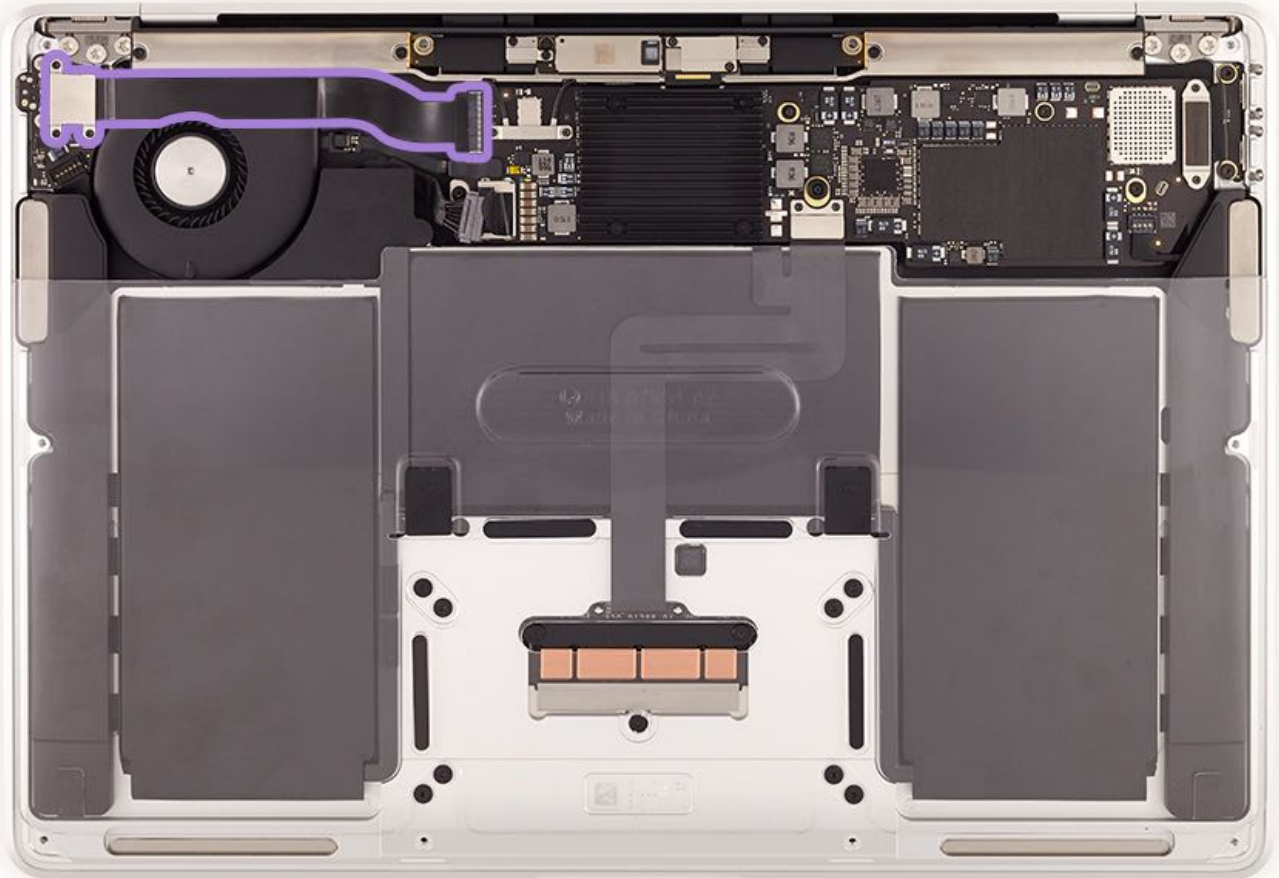
- Attach the battery cover and disconnect the battery immediately after removing the bottom case.
- Do not apply external power while the computer is under repair.

Important:

- Only Apple-certified technicians should perform this procedure. For more information, refer to [OP1859: About Apple service certifications](#).
- Wear an ESD wrist strap and take precautions to avoid ESD.

Remove:

- [Bottom Case](#)



Tools

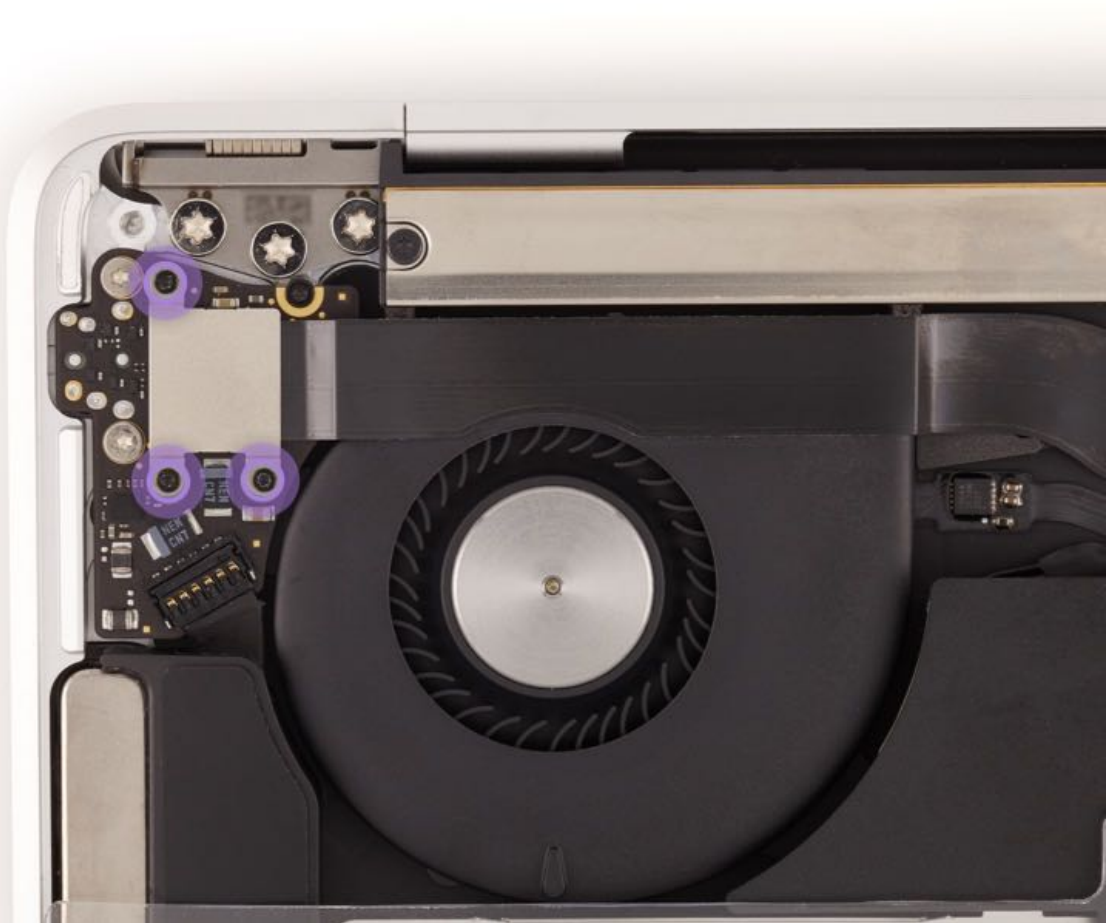
1. Torx T3 screwdriver (magnetized)
2. Black stick



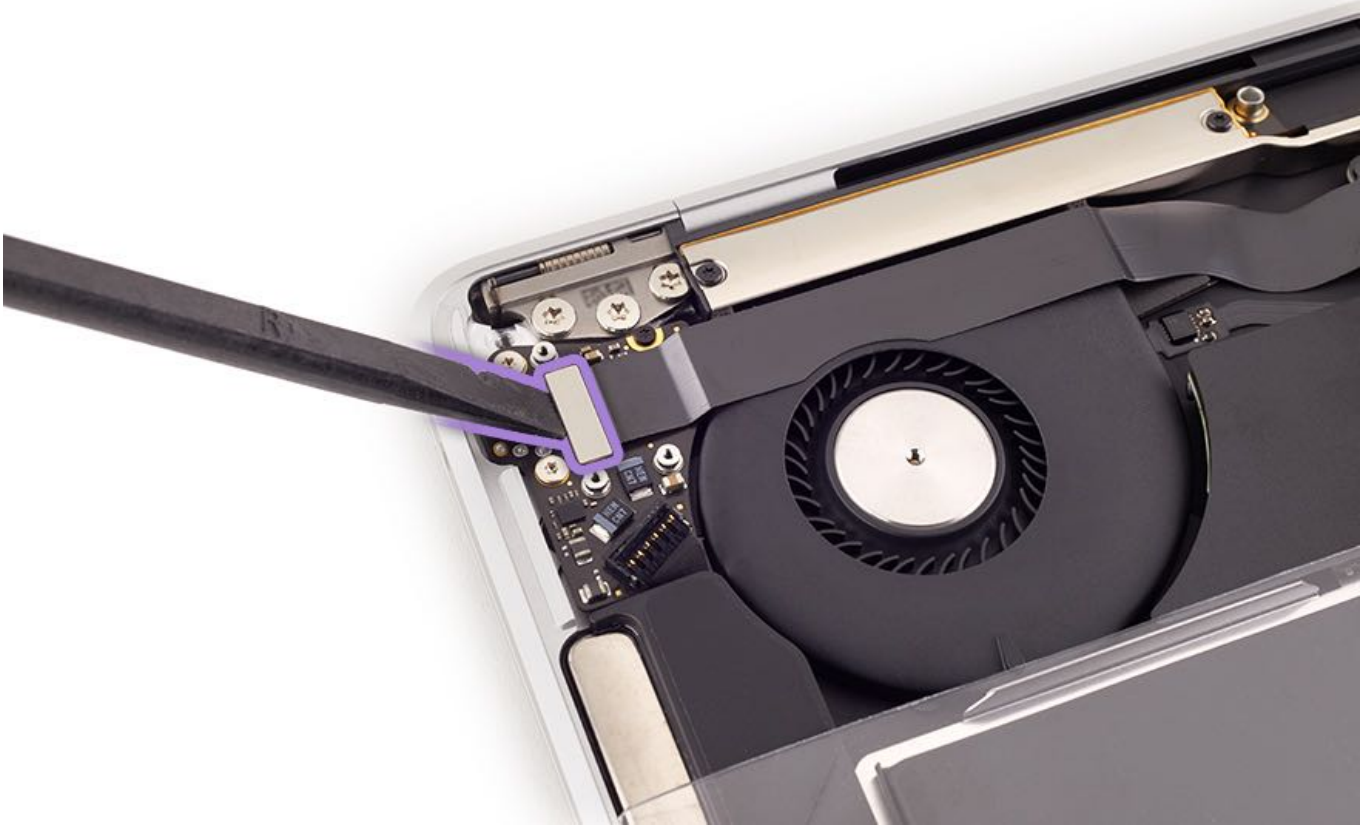
Steps For Removal

1. Remove three T3 screws from the audio board and Touch ID cowling.

- T3: 923-02885



2. Disconnect the flex cable from the audio board.



3. Disconnect the flex cable from the logic board side and gently disengage from the fan.



Steps For Reassembly

1. Reconnect the flex cable into the locking lever connector on the logic board and adhere to the fan. Lock the connector.

2. Reconnect the flex cable into the platform flex connector on the audio board.
3. Reinstall the [bottom case](#).
4. Trackpad performance must be validated after every repair. For instructions, refer to article [TP1314: Trackpad Calibration Check](#).

Audio Board

First Steps



Warning:

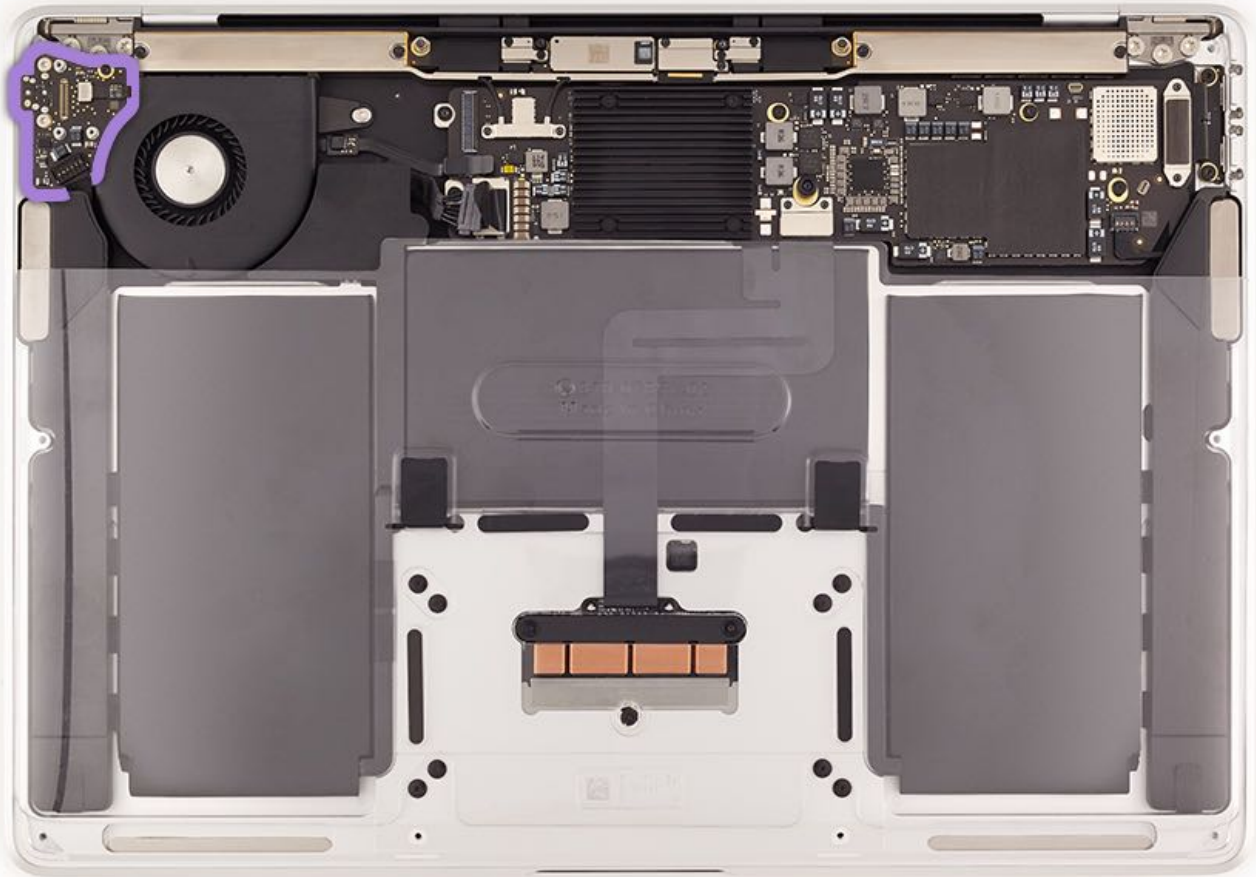
- Attach the battery cover and disconnect the battery immediately after removing the bottom case.
- Do not apply external power while the computer is under repair.

Important:

- Only Apple-certified technicians should perform this procedure. For more information, refer to [OP1859: About Apple service certifications](#).
- Wear an ESD wrist strap and take precautions to avoid ESD.

Remove:

- [Bottom Case](#)
- [Audio Board Flex Cable](#)



Tools

1. Torx T3 screwdriver (magnetized)
2. Torx T5 screwdriver (magnetized)



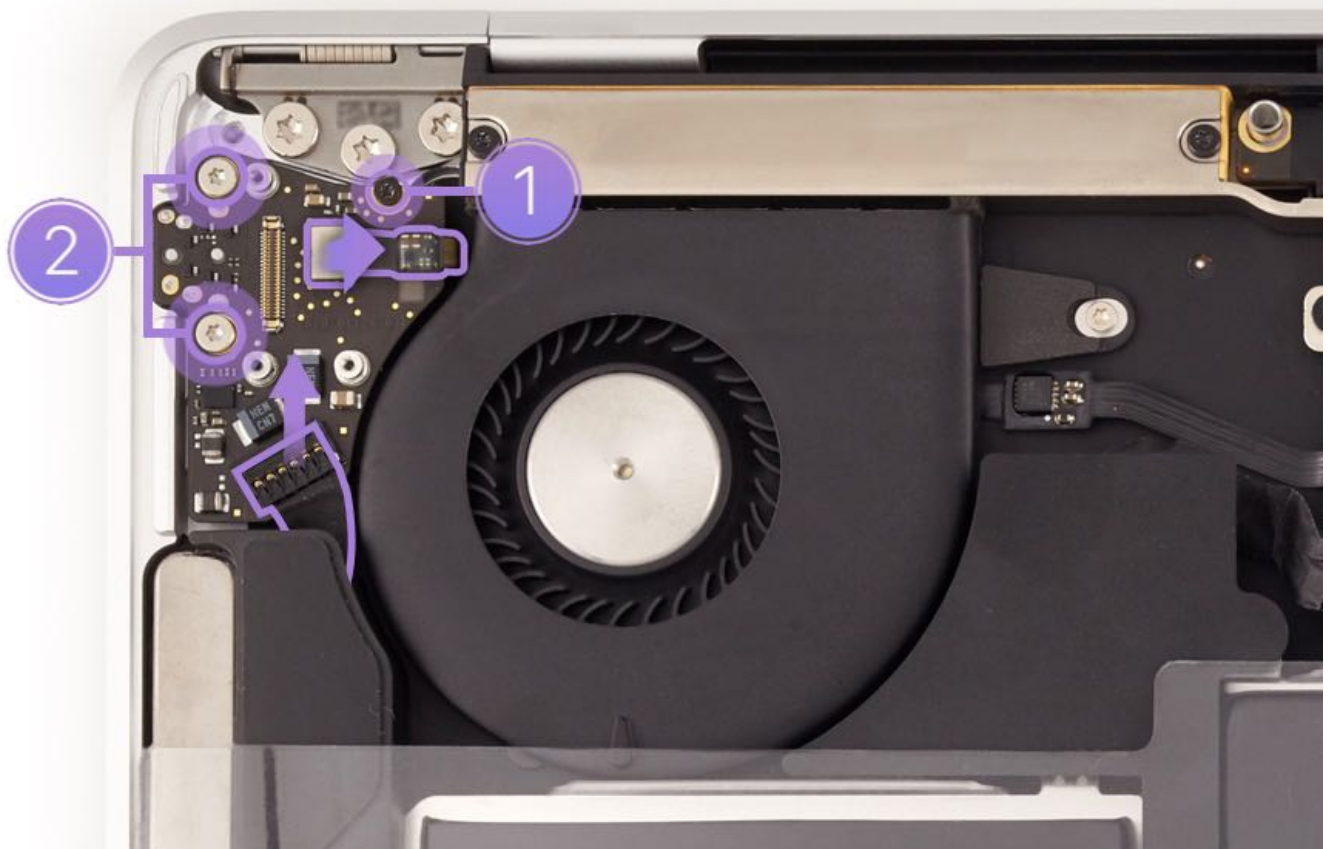
Steps For Removal

1. Remove one black T3 screw (1) and two silver T5 screws (2) from the audio board. Disconnect the Touch ID flex cable and the speaker flex cable.

- T5: 923-02881 (2)



- T3: 923-02884 (1)



2. Hold the board by the edges and gently wiggle out of the port.



Steps For Reassembly

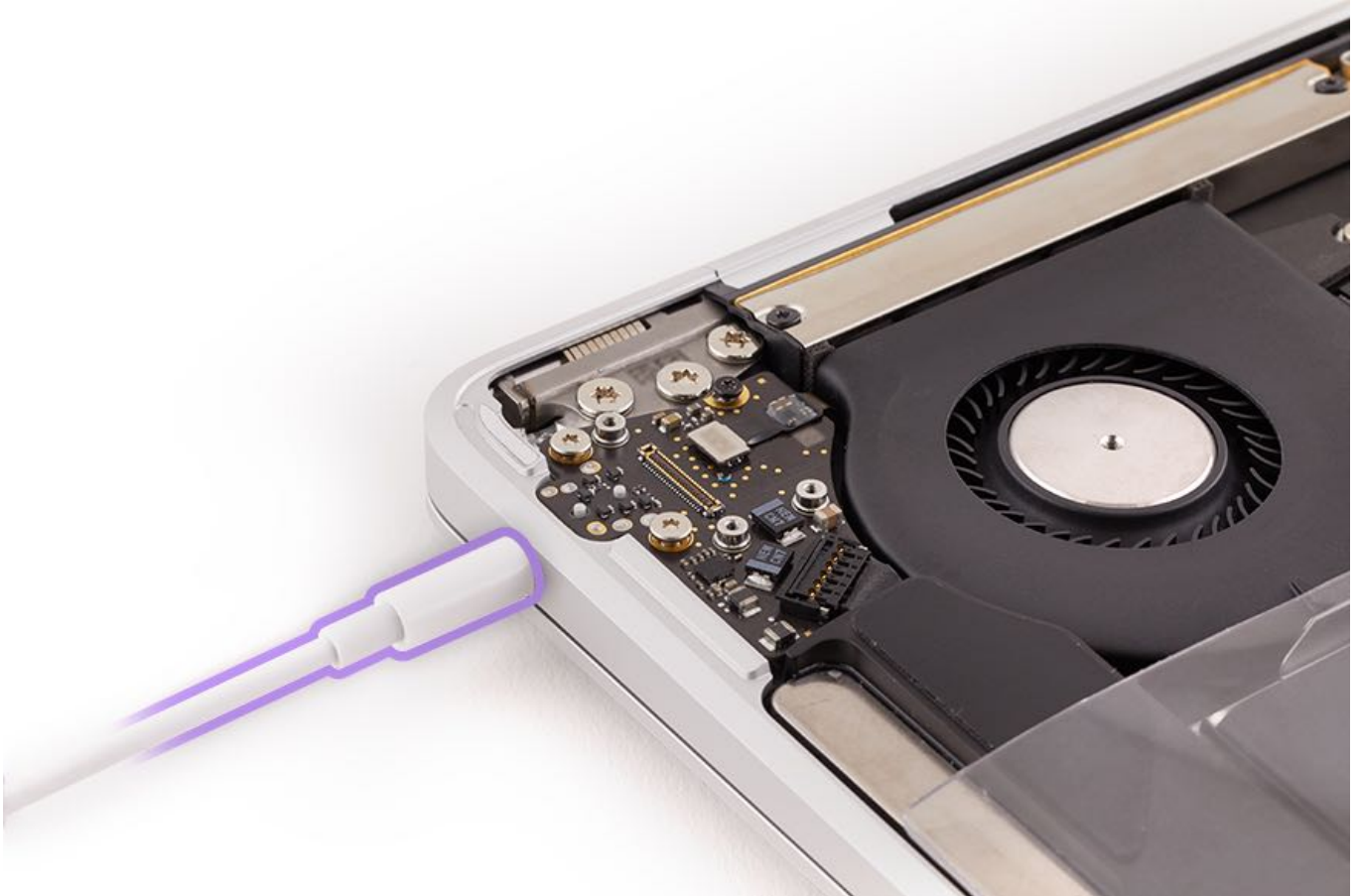
Note: Be sure to order the correct part when replacing the audio board.

- Space Gray or Gold: 923-02823
- Silver: 923-02824

1. Reinstall the audio board.



2. Reconnect the Touch ID flex cable and the speaker flex cable and loosely reinstall the three screws into the audio board.
3. Plug in a 3.5 mm jack to check alignment.



4. Tighten the audio board screws.
5. Reinstall the [audio board flex cable](#).
6. Reinstall the [bottom case](#).
7. Verify the trackpad performance after every repair. For instructions, refer to [TP1314: Trackpad Calibration Check](#).

Fan

First Steps



Warning:

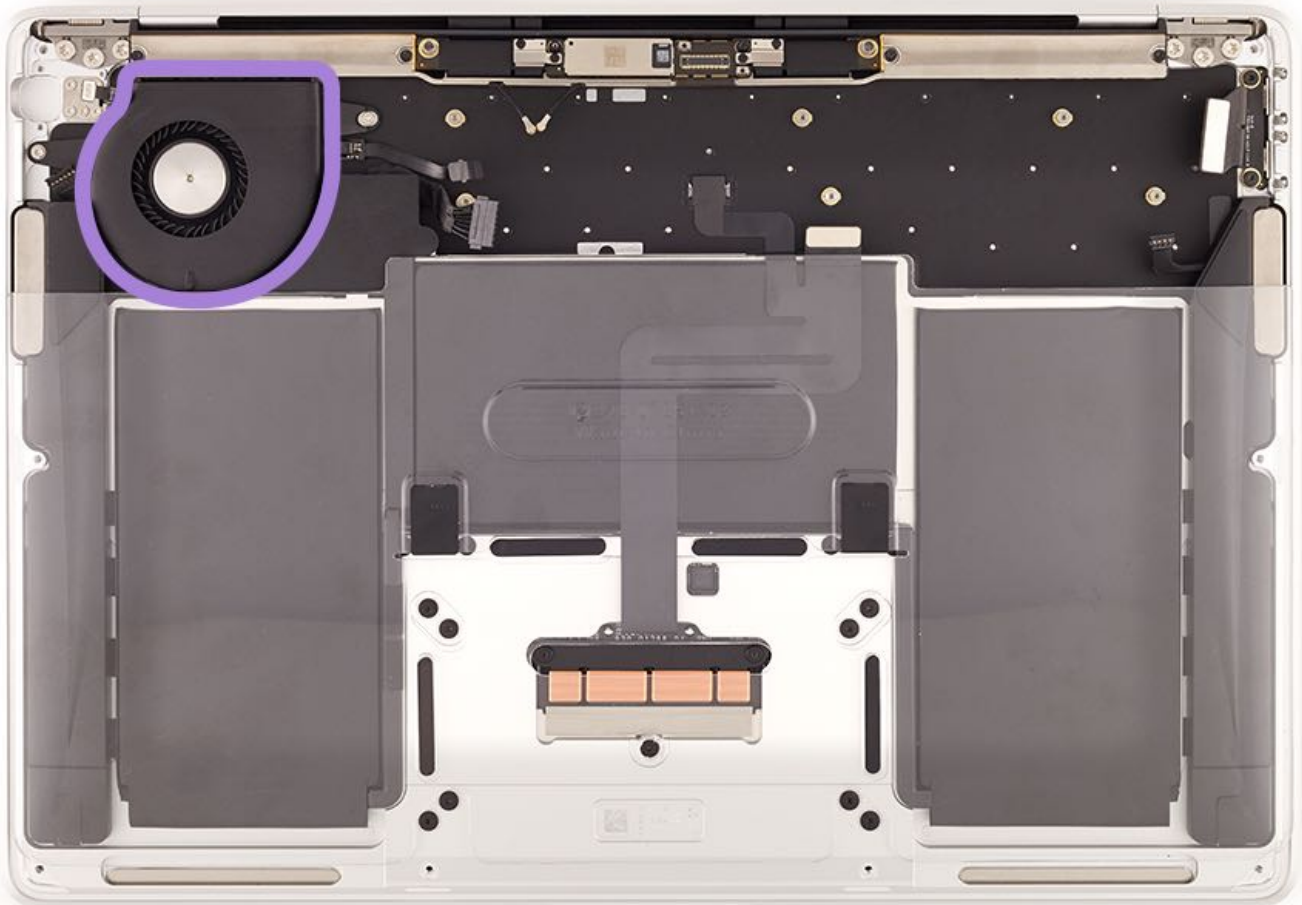
- Attach the battery cover and disconnect the battery immediately after removing the bottom case.
- Do not apply external power while the computer is under repair.

Important:

- Only Apple-certified technicians should perform this procedure. For more information, refer to [OP1859: About Apple service certifications](#).
- Wear an ESD wrist strap and take precautions to avoid ESD.

Remove:

- [Bottom Case](#)
- [Logic Board](#)
- [Audio Board Flex Cable](#)
- [Audio Board](#)



Tools

1. Torx T5 screwdriver (magnetized)
2. Black stick



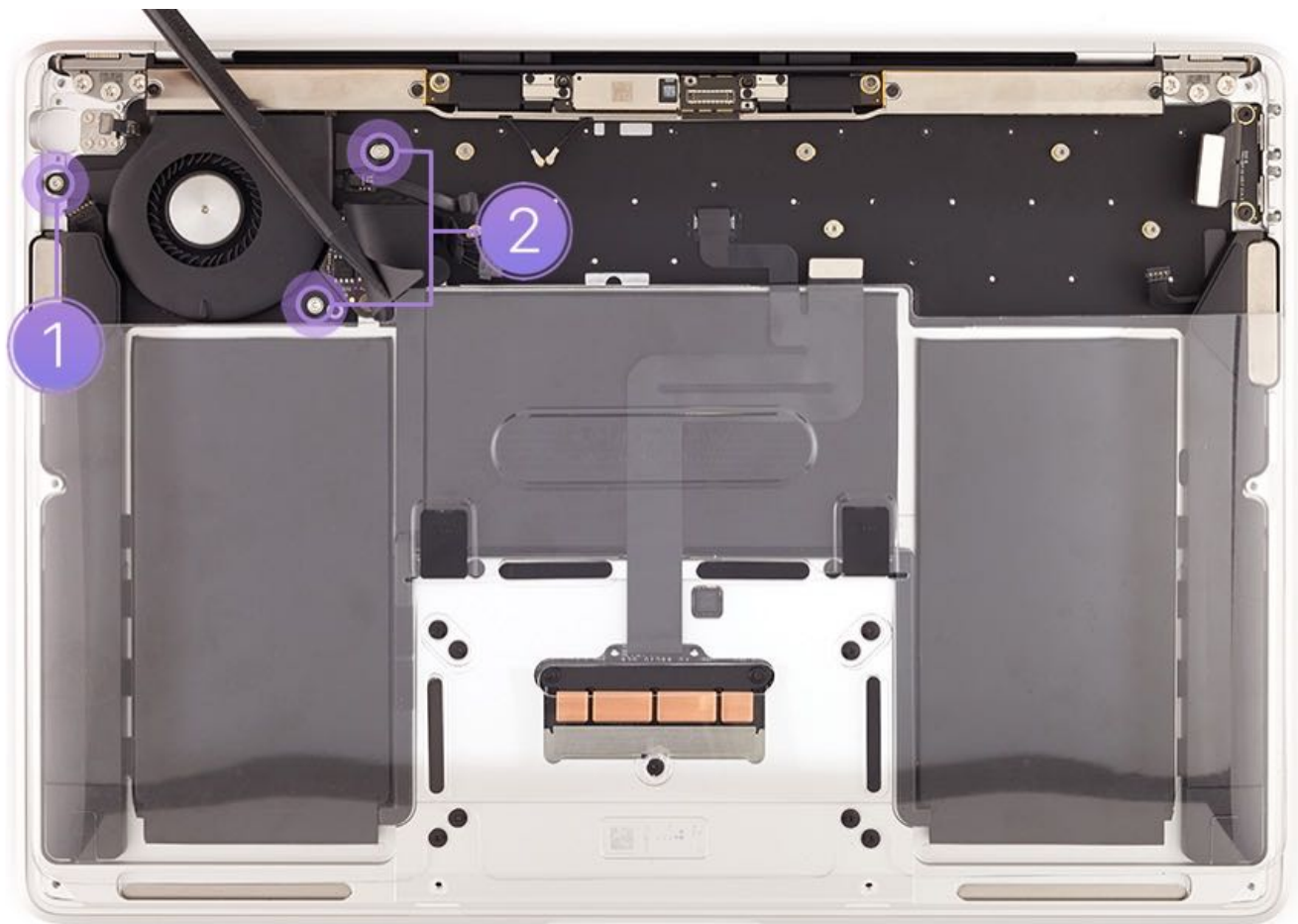
Steps For Removal

1. Remove three T5 fan screws. **Note:** One screw is hidden under the BMU Mylar. It is necessary to peel back the Mylar to reach that screw.

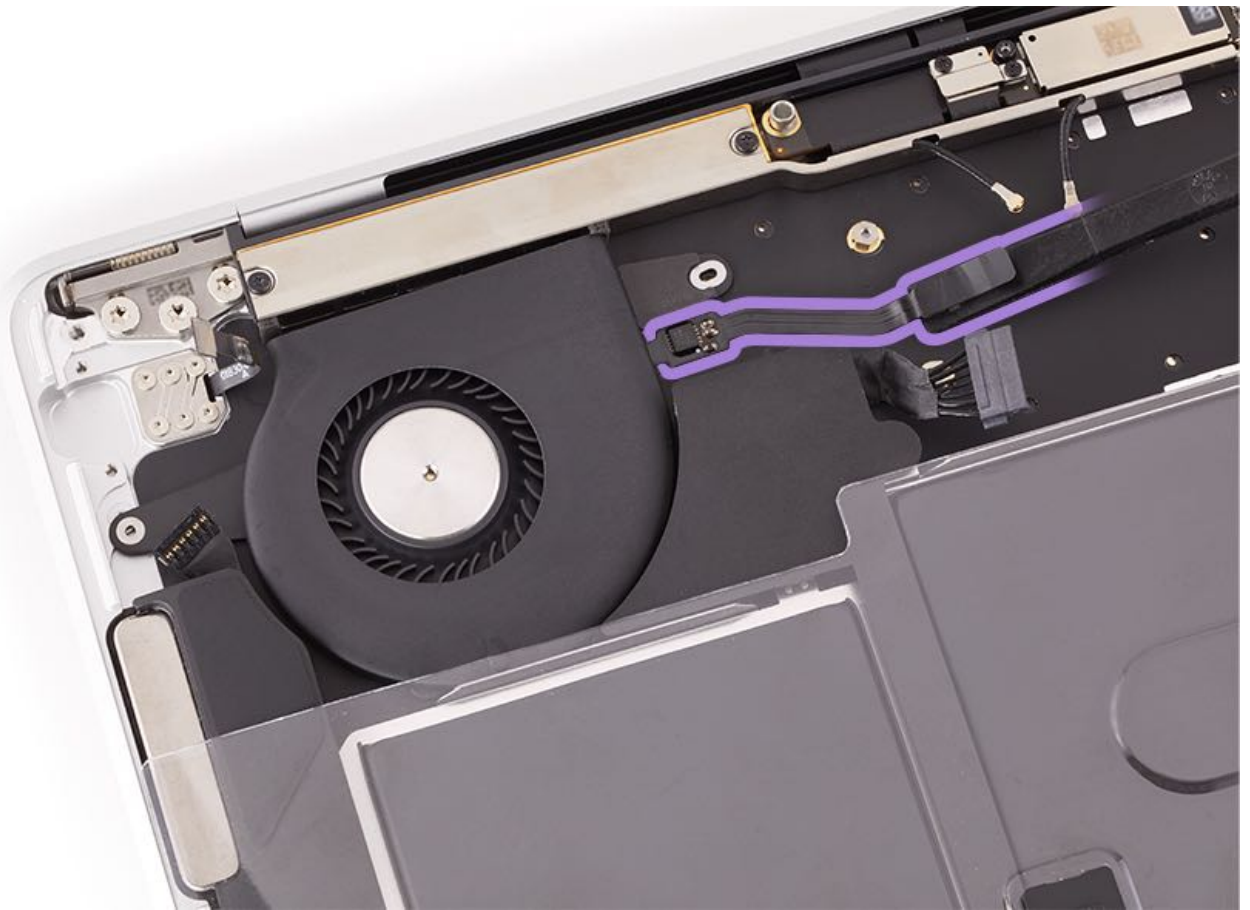
- T5: (923-02886) (1) (position 1)



- T5: (923-02887) (2) (position 2)



2. Disconnect the fan flex cable and use a black stick to gently peel the flex cable from the top case. Remove the fan from the top case.



Steps For Reassembly

1. Place the fan in the top case and align the screw holes in the fan with the screw holes in the top case.

Important: Screw placement of the screw in the lower right corner is different for ISO/ANSI keyboard computers and JIS keyboard computers. For ISO/ANSI the screw goes inside (1) and for JIS the screw goes on the outside (2).



2. Tighten the screws.
3. Reconnect the fan flex cable and adhere the cable to the top case.
4. Reinstall the [audio board](#).
5. Reinstall the [audio board flex cable](#).
6. Reinstall the [logic board](#).

7. Reinstall the [bottom case](#).



8. **Caution:** This repair is not complete until the System Configuration has been performed. For instructions, refer to [TP1657: System Configuration for Macs with the Apple T2 Security Chip](#). Failure to perform this step will result in an inoperative system and an incomplete repair.

9. After System Configuration is performed, verify the trackpad performance with Trackpad Calibration Check. For instructions on trackpad calibration, refer to [TP1314: Trackpad Calibration Check](#).

Touch ID Board

First Steps



Warning:

- Attach the battery cover and disconnect the battery immediately after removing the bottom case.
- Do not apply external power while the computer is under repair.

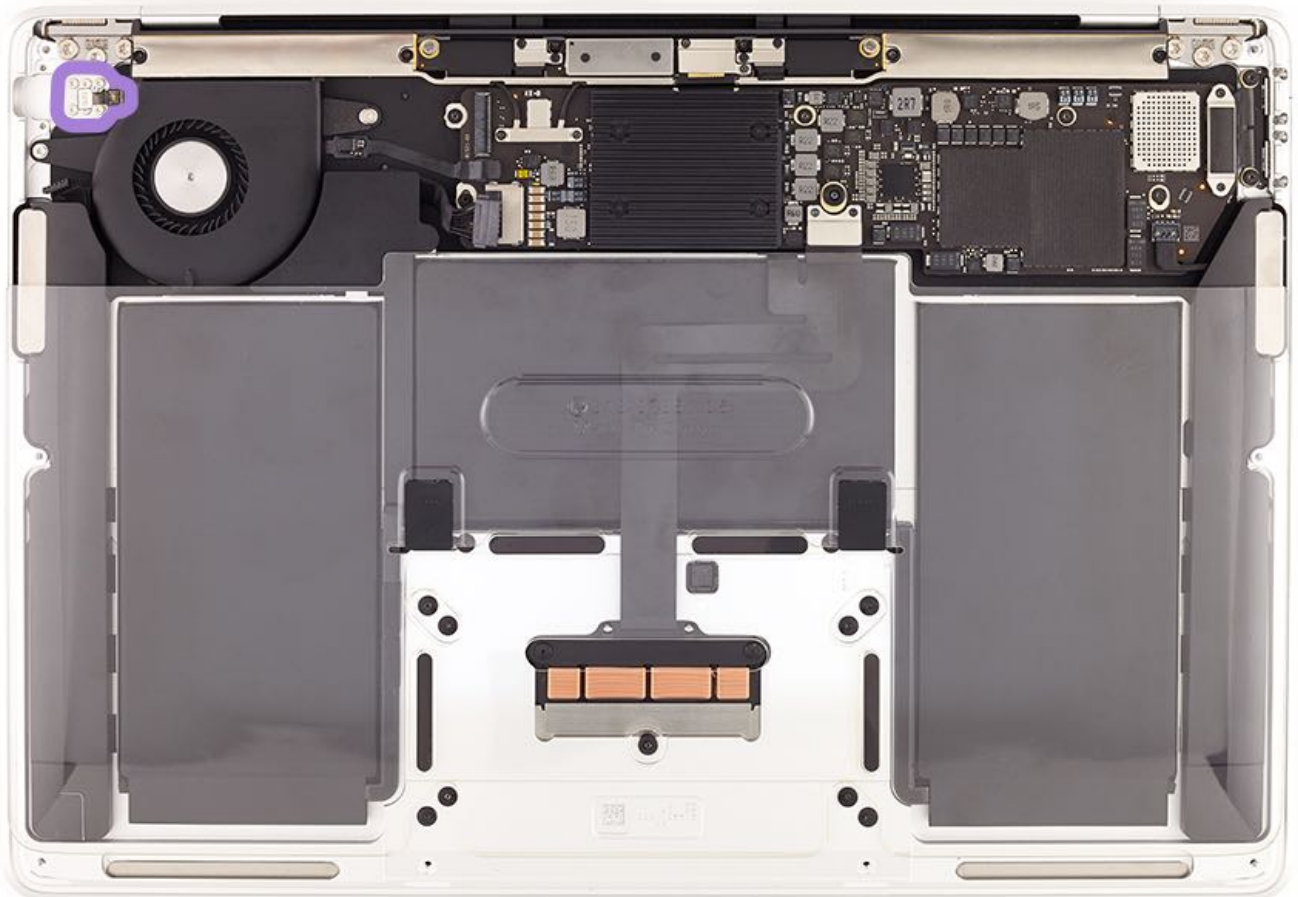
Important:

- Only Apple-certified technicians should perform this procedure. For more information, refer to [OP1859: About Apple service certifications](#).
- Wear an ESD wrist strap and take precautions to avoid ESD.

For video instruction, refer to article [SV393: Touch ID Board Replacement Video](#).

Remove:

- [Bottom Case](#)
- [Audio Board Flex Cable](#)
- [Audio Board](#)



Tools

1. Torx T3 screwdriver
2. Touch ID alignment kit including edge guide and Touch ID alignment tool (923-03032)
3. Flat-nosed, ESD-safe tweezers

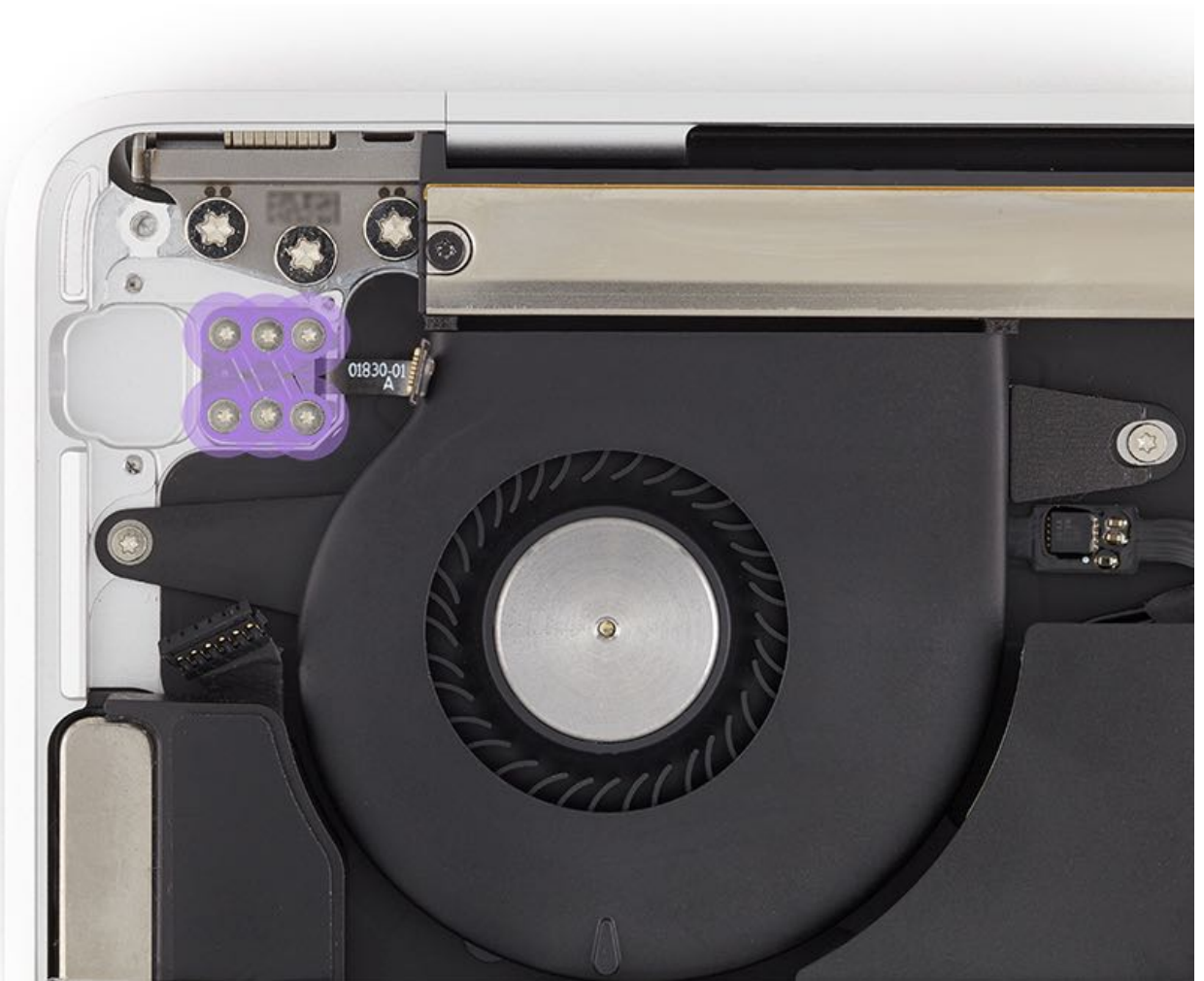


Steps For Removal

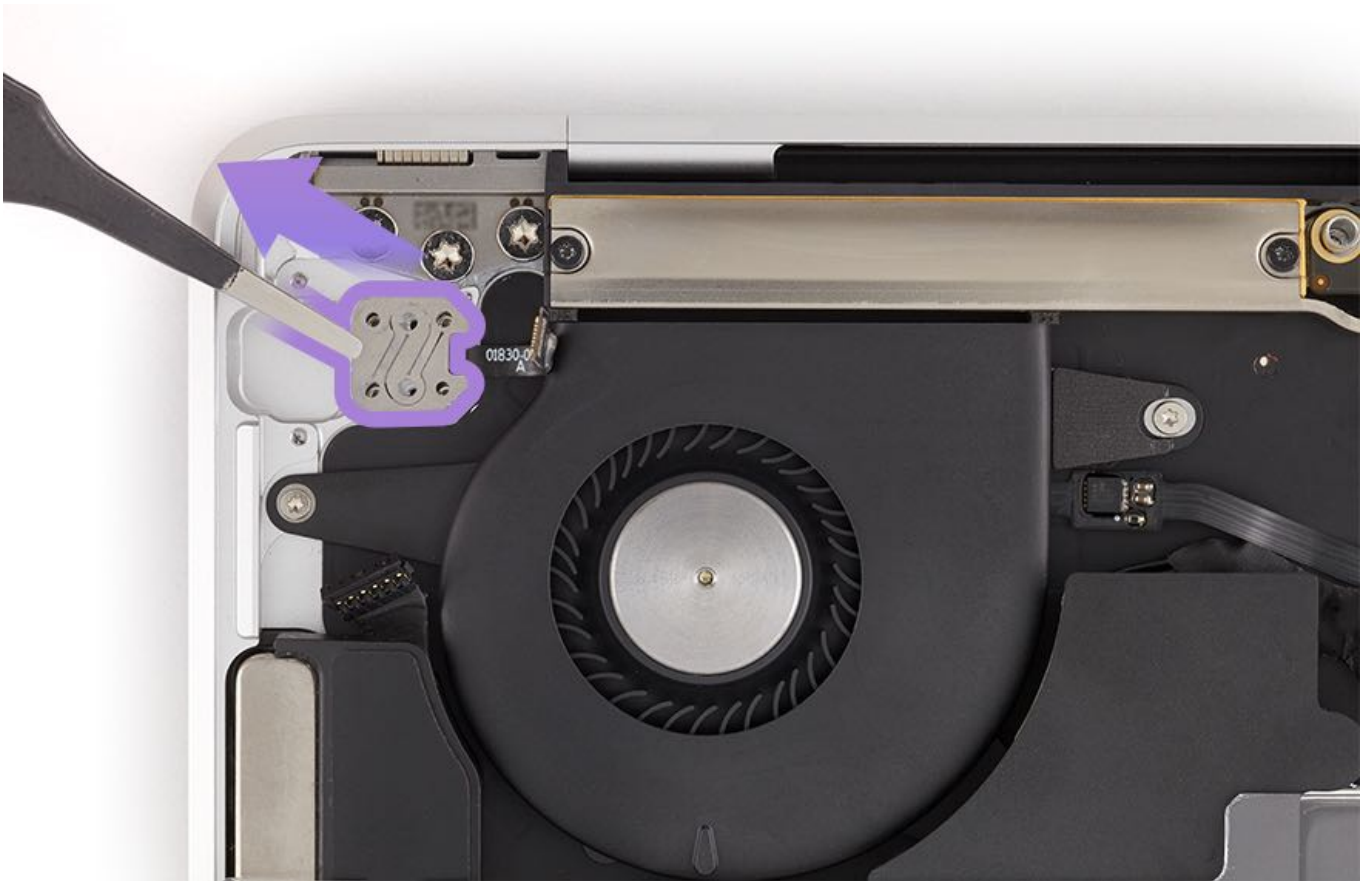
Important: The Touch ID board is paired with the logic board, however the Touch ID board (661-11677) can be replaced on its own. The logic board does not also have to be replaced.

1. Remove the six T3 screws from the flexure.

- T3: 923-02888



2. Use tweezers to remove the flexure. Set aside for reuse.



3. Open the display and stand the computer assembly on its side. With a hand on each side of the top case, support the Touch ID board as you thread the flex cable through the slot. Remove the Touch ID board from the keyboard side of the top case.



Steps For Reassembly

Note: If you are installing a replacement Touch ID board, remove the protective film from the glass surface.

1. With the computer still on its side, thread the flex cable through the slot in the top case.



2. Using tweezers, reinstall the flexure. Be sure it is installed right side up or the button may not function properly.



3. Hold the flexure in place while inserting the screws. Reinstall the outside screws first.



4. Loosely install the middle screws.



5. Place the computer flat on the ESD mat, be careful not to bend the Touch ID flex cable. **Warning:** Be sure the battery cover is attached.

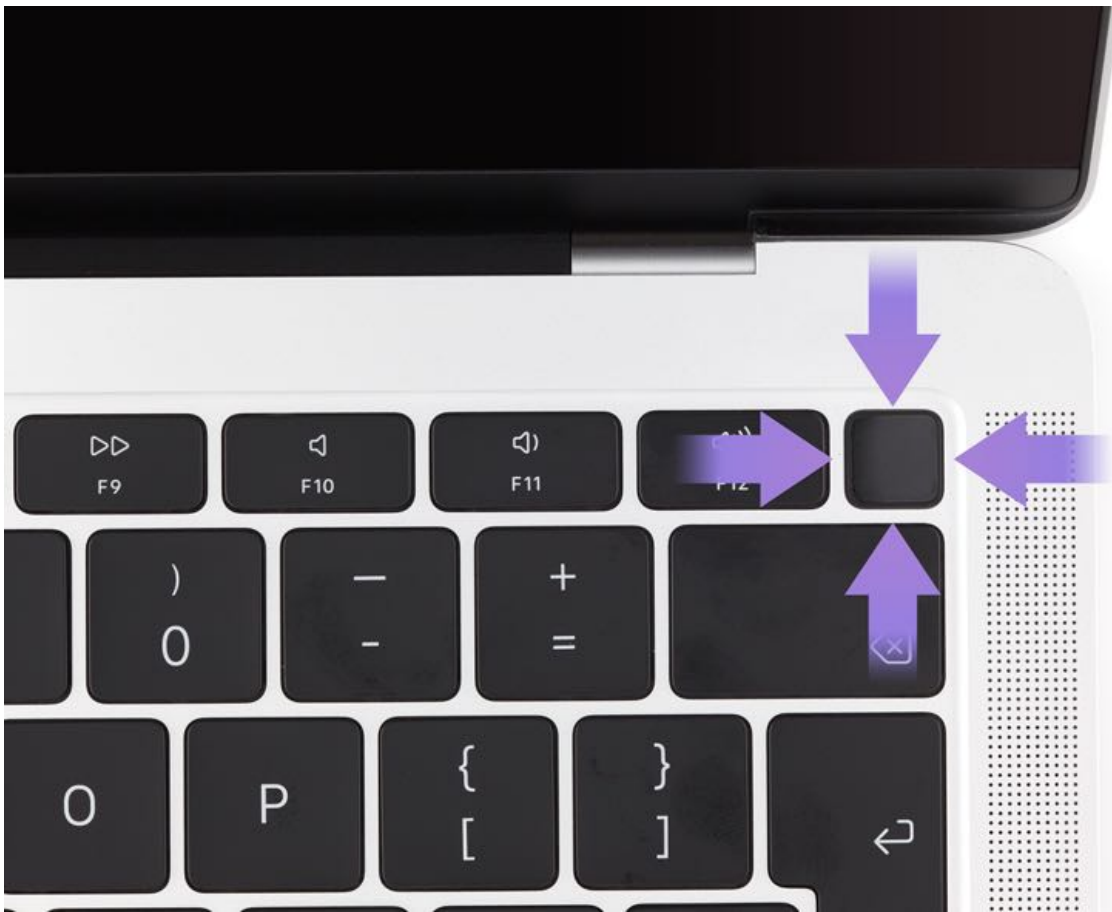
6. Insert the three tabs of the Touch ID alignment tool into the Touch ID bay.



7. Place the computer back on its side and lightly push the edge tool as you tighten the two middle screws.



8. Remove the alignment tool and look at the Touch ID button to verify that all the sides are spaced equally. If not, start the alignment process again with step 5.



9. Press the Touch ID button to verify that it makes a clicking noise. If the button does not move at all or moves but does not click, refer to [RP1352: Touch ID Shim](#) for details.

10. Reinstall the [audio board](#).

11. Reinstall the [audio board flex cable](#).

12. Reinstall the [bottom case](#).

13. Verify the trackpad performance with Trackpad Calibration Check. For instructions on trackpad calibration, refer to [TP1314: Trackpad Calibration Check](#).

Touch ID Shim

First Steps



Warning:

- Attach the battery cover and disconnect the battery immediately after removing the bottom case.
- Do not apply external power while the computer is under repair.

Important:

- Only Apple-certified technicians should perform this procedure. For more information, refer to [OP1859: About Apple service certifications](#).
- Wear an ESD wrist strap and take precautions to avoid ESD.

Note: The images shown are of MacBook Pro (13-inch, Four Thunderbolt 3 Ports), however the process is the same for MacBook Air (Retina, 13-inch, 2018).



Tools

- Torx T3 screwdriver (magnetized)
- ESD-safe round-nose tweezers
- Shim kit, package of 3 (923-01519), not shown



Steps For Removal

Note: The Touch ID shim is a tiny, circular part. Make sure your work surface is completely clean. A clean surface allows easy location of the shim if it lands on the ESD mat during a Touch ID shim repair.

1. Determine the required Touch ID shim size:

- If the button feels too loose or does not click, a larger shim is required.
- If the button feels too stiff or does not move, a smaller shim is required.



2. Spread the tips of the round-nose tweezers, and use one tip to push the shim out.



3. Retrieve the loose shim on the keyboard side of the top case. The shim has a small bit of adhesive, and may stick to the top case. The shim is black on the adhesive side and silver on the opposite side.



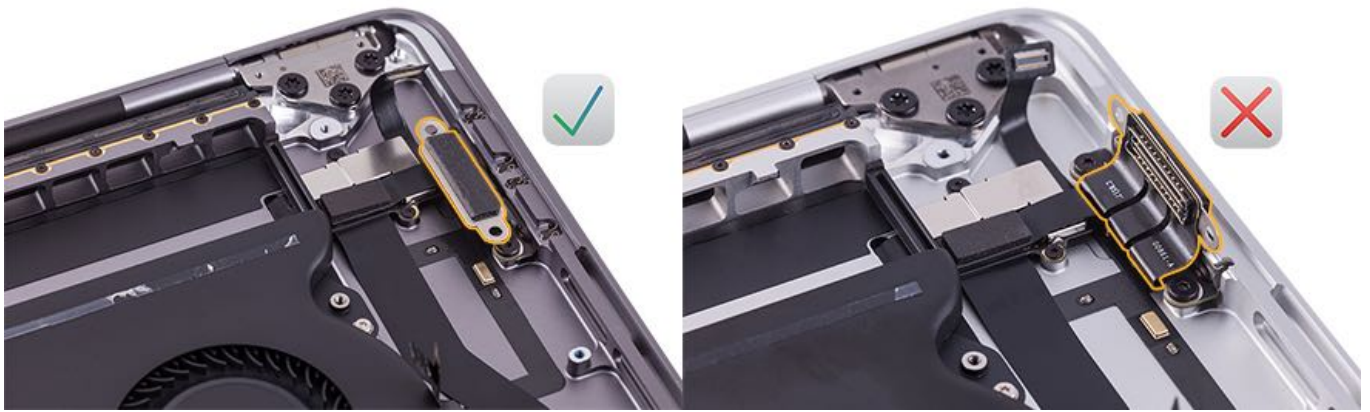
Steps For Reassembly

1. Replace the Touch ID shim with one of the supplied shims from the kit (923-01519), which are marked and organized by size.

- Use tweezers to remove the appropriate shim from the backing.
- Keep less than half of the shim on the tweezer head for easier installation.

2. Set the computer flat on the ESD mat.

Important: For MacBook Pro models, be sure the battery cover is in position and the left and right I/O boards are flat.



3. Align the shim in the recessed circle on the top case.



4. Gently press the shim to activate the adhesive.



5. Return to the Touch ID board service guide article to continue with the reinstallation of the Touch ID board.

- For MacBook Pro (13-inch, 2016, 2017, and 2018, Four Thunderbolt 3 Ports), refer to [RP1346: Touch ID Board](#).
- For MacBook Air (Retina, 13-inch, 2018), refer to [RP1463: Touch ID Board](#).

Note: Confirm that Touch ID and the power button function correctly with the new shim installed.

Important: For MacBook Pro models, apply new adhesive to the [Touch ID board flex cable](#).

Embedded DisplayPort (eDP) Flex Cable

First Steps



Warning:

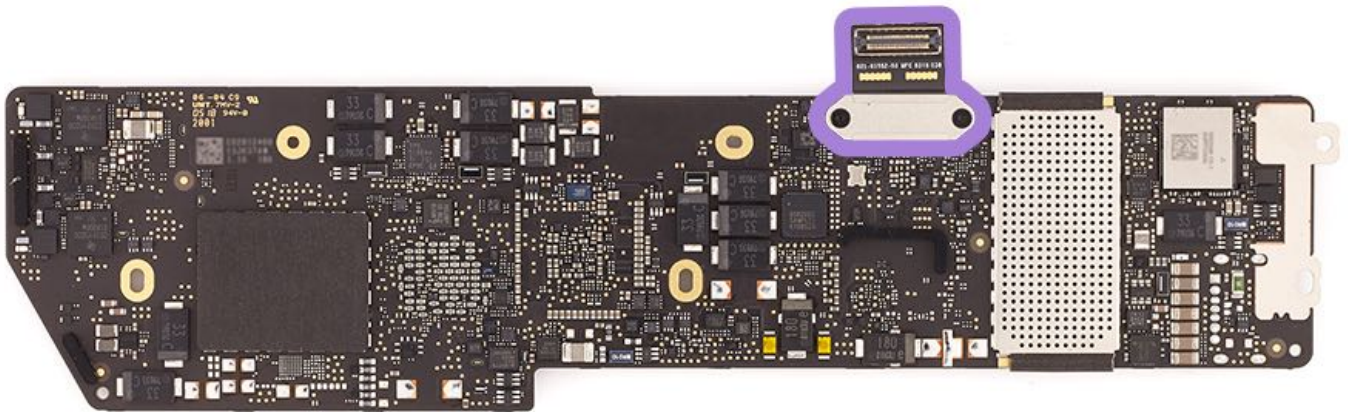
- Attach the battery cover and disconnect the battery immediately after removing the bottom case.
- Do not apply external power while the computer is under repair.

Important:

- Only Apple-certified technicians should perform this procedure. For more information, refer to [OP1859: About Apple service certifications](#).
- Wear an ESD wrist strap and take precautions to avoid ESD.

Remove:

- [Bottom Case](#)
- [Logic Board](#)



Tools

1. Torx T3 screwdriver (magnetized)
2. Black stick

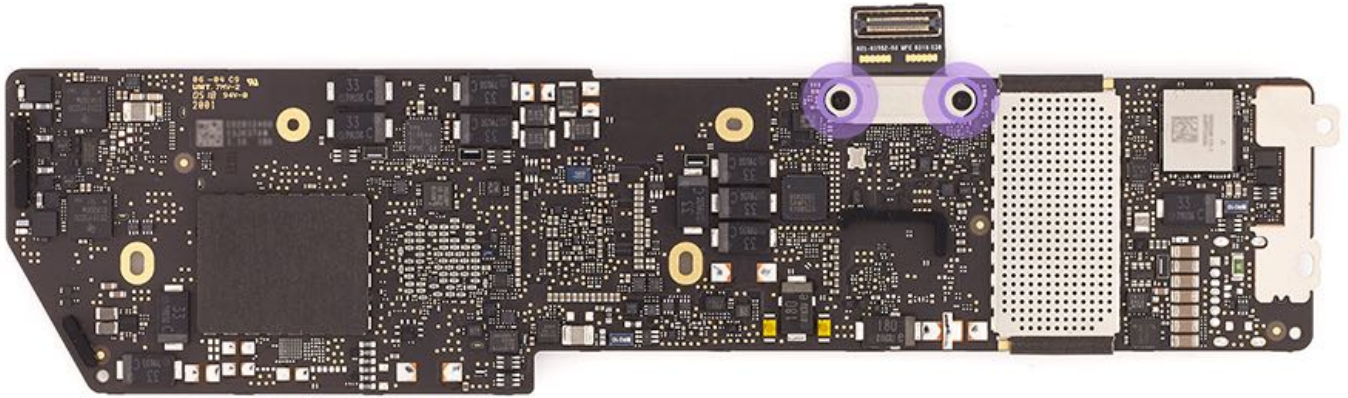


Steps For Removal

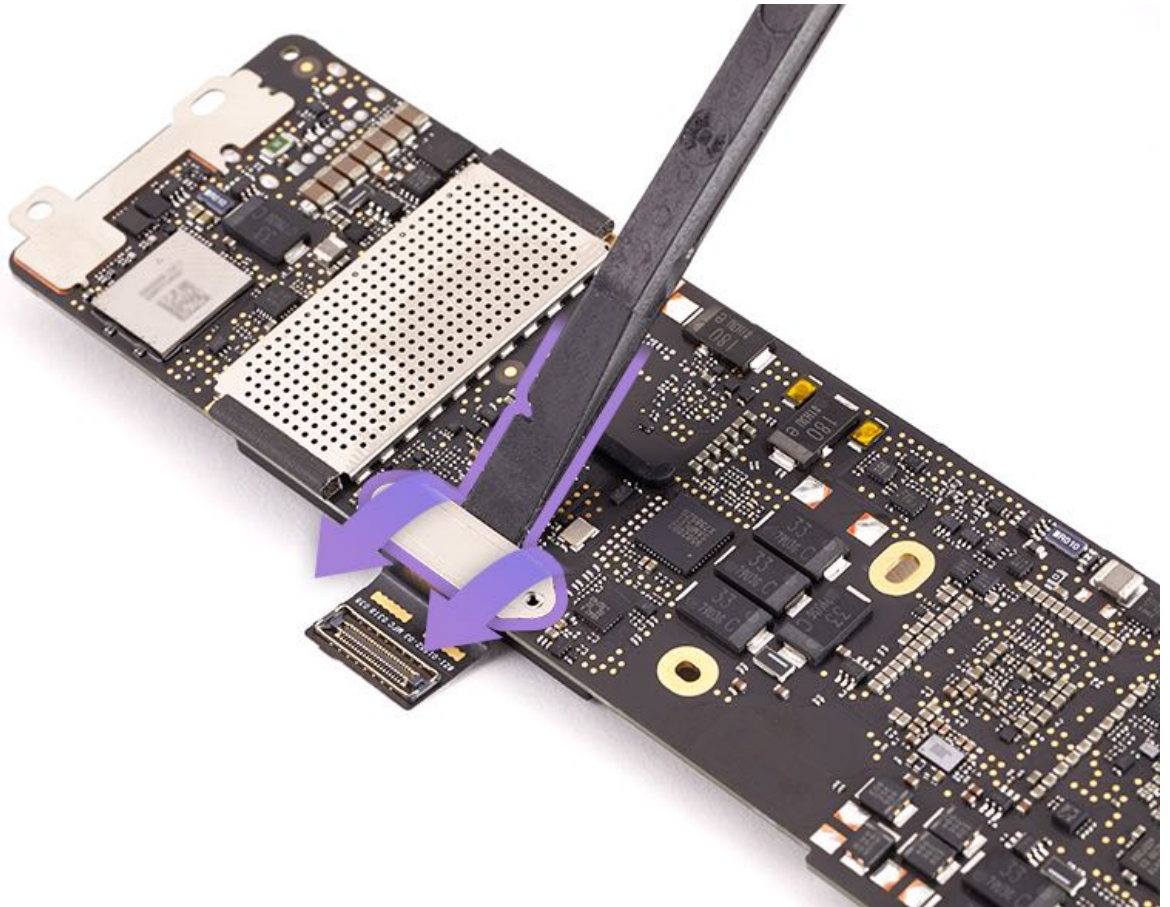
1. Turn the logic board over.
2. Remove two T3 screws from the eDP flex cable cowling.

- T3: 923-02885





3. Use a black stick to disconnect the eDP flex cable from the logic board.



Steps For Reassembly

1. Reassemble in reverse order of removal steps.
2. Reinstall the [logic board](#).
3. Reinstall the [bottom case](#).



4. **Caution:** This repair is not complete until the System Configuration has been performed. For instructions, refer to [TP1657: System Configuration for Macs with the Apple T2 Security Chip](#). Failure to perform this step will result in an inoperative system and an incomplete repair.

5. After System Configuration is performed, verify the trackpad performance with Trackpad Calibration Check. For instructions on trackpad calibration, refer to [TP1314: Trackpad Calibration Check](#).

Display Assembly

First Steps



Warning:

- Attach the battery cover and disconnect the battery immediately after removing the bottom case.
- Do not apply external power while the computer is under repair.

Important:

- Only Apple-certified technicians should perform this procedure. For more information, refer to [OP1859: About Apple service certifications](#).
- Wear an ESD wrist strap and take precautions to avoid ESD.

Remove:

- [Bottom Case](#)
- [Logic Board](#)
- [Vent/Antenna module](#)



Tools

1. Torx T8 screwdriver



Steps For Removal

1. Open the display and place the computer on the edge of a workbench, with the display hanging down.



2. Remove six T8 display hinge screws.

- T8: 923-02894





3. Separate the display assembly from the top case. Pull the display toward you just short of full extension (1), then lift the display up and off the top case (2).



Steps For Reassembly

Note: The display assembly module includes the TCON board and the spring tensioners. When reinstalling the display assembly, be sure the module does not get crimped or caught on the outside of the display.



1. Reinstall the display onto the top case.



2. Loosely reinstall the six T8 display hinge screws in the order shown.



3. Close the top case and check the display alignment. Adjust as necessary until the top case and bottom case are aligned.
4. Tighten all six screws.
5. Reinstall the [vent/antenna module](#).
6. Reinstall the [logic board](#).
7. Reinstall the [bottom case](#).



8. **Caution:** This repair is not complete until the System Configuration has been performed. For instructions, refer to [TP1657: System Configuration for Macs with the Apple T2 Security Chip](#). Failure to perform this step will result in an inoperative system and an incomplete repair.
9. After System Configuration is performed, verify the trackpad performance with Trackpad Calibration Check. For instructions on trackpad calibration, refer to [TP1314: Trackpad Calibration Check](#).

Trackpad

First Steps



Warning:

- Attach the battery cover and disconnect the battery immediately after removing the bottom case.
- Do not apply external power while the computer is under repair.

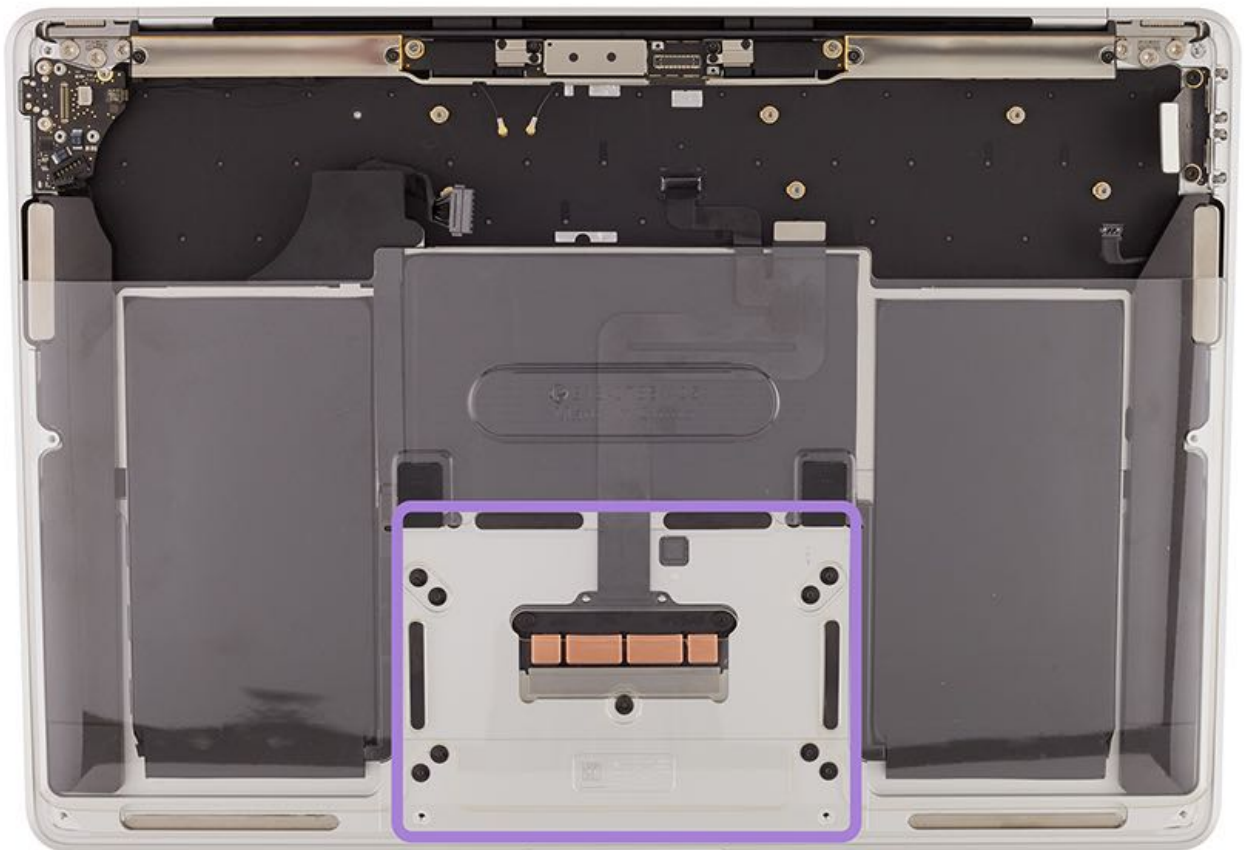
Important:

- Only Apple-certified technicians should perform this procedure. For more information, refer to [OP1859: About Apple service certifications](#).
- Wear an ESD wrist strap and take precautions to avoid ESD.

For video instruction, refer to article [SV391: Trackpad Replacement Video](#).

Remove:

- [Bottom Case](#)
- [Logic Board](#)



Tools

1. 0.3–1.2 Nm torque driver (set to 0.35 Nm) (923-0735)
2. 10–34 Ncm torque driver (set to 16 Ncm) (923-02995)
3. T5 security bit
4. Torx T5 screwdriver
5. Black stick
6. Gap offset tools (923-02998)
7. Post-It Notes
8. Kapton tape
9. ESD-safe, flat-nosed tweezers



Steps For Removal

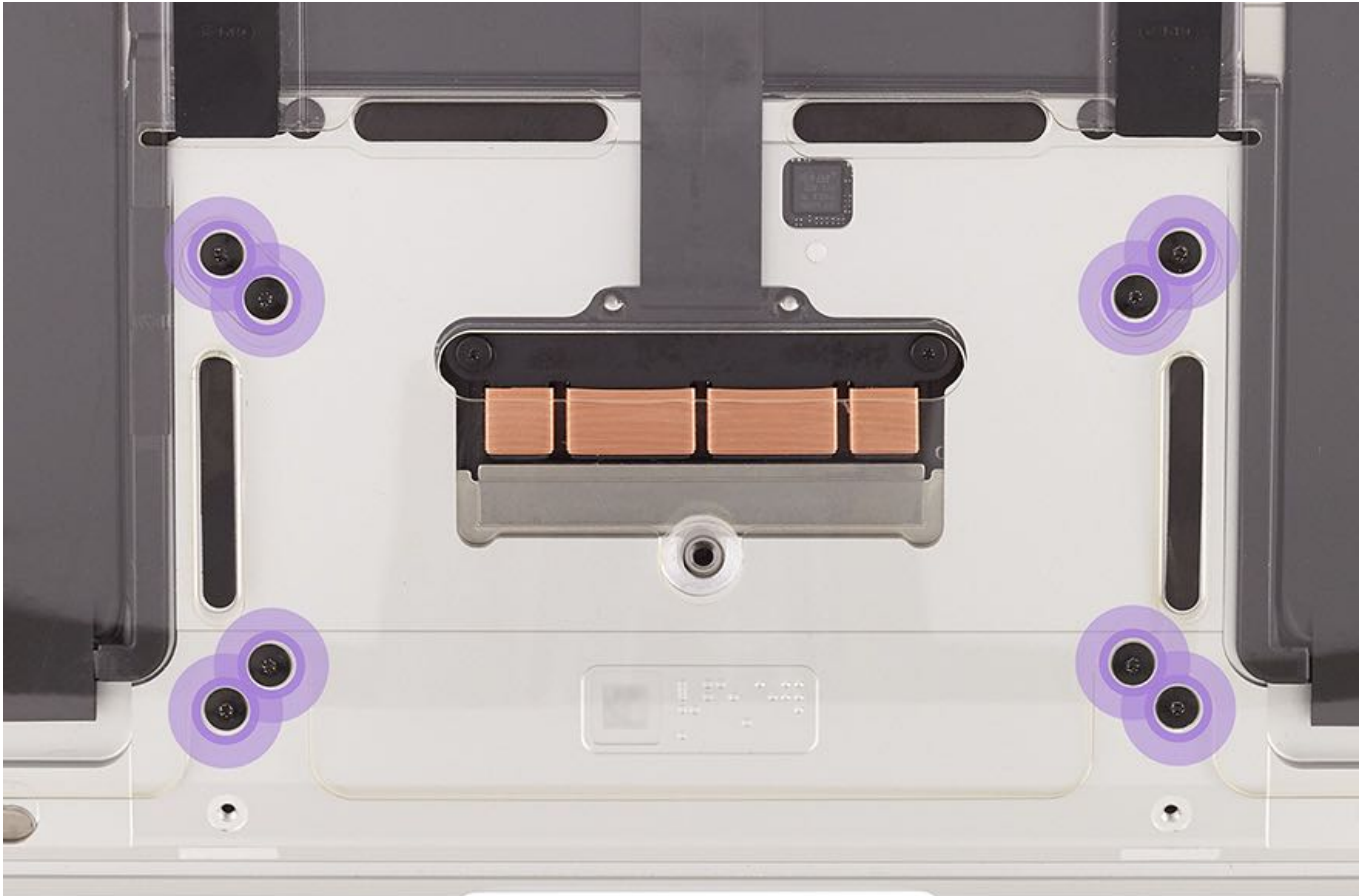
1. Open the computer and place the top case on the table with the display over the table edge.
2. Remove one T5 middle screw.

- T5: 923-03002

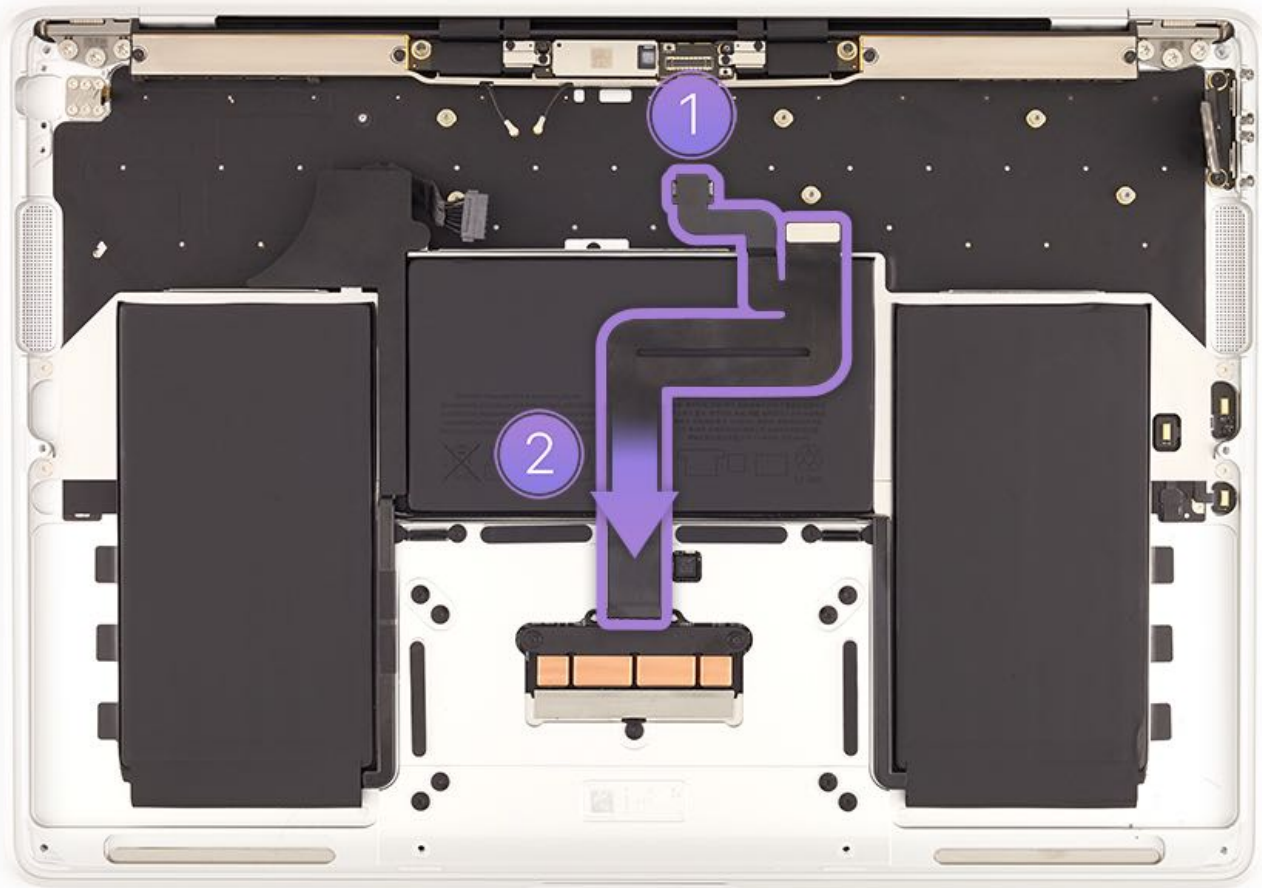


3. Remove eight T5 outer screws.

- T5: 923-02880



4. Remove the battery cover to disconnect the keyboard flex cable and carefully separate the adhesive from the battery cell.



5. Lift the computer assembly off the table while threading the trackpad cable through the top case opening.



6. Set the computer assembly aside. Turn the trackpad over so the shims fall on the table. Do not reuse the shims.

Steps For Reassembly

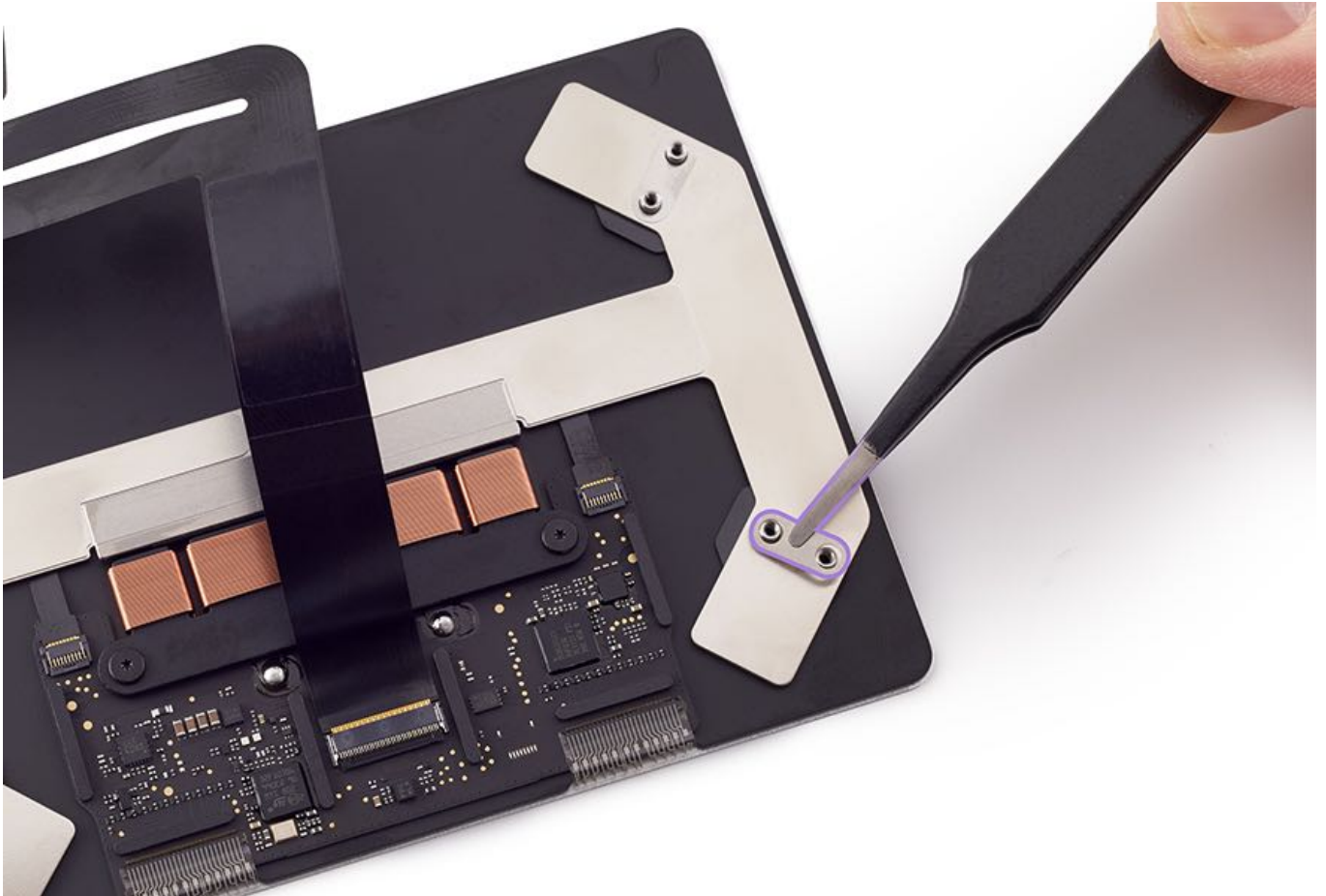
Note: If reinstalling the trackpad, do not remove the trackpad flex cable from the trackpad unless it is damaged. If installing a new trackpad, replace the trackpad flex cable with a new one that is included with the replacement part. The replacement trackpad comes with two flex cables. Find the number on the back of the original trackpad and match it to the new one.

- JIS 821-01914
- ANSI/ISO 821-01833

For information on replacing the trackpad flex cable, refer to [Trackpad Flex Cable](#).

1. Using ESD-safe, flat-nosed tweezers, install new shims to the outer screw bosses and the middle screw boss on the replacement trackpad.

Note: The replacement trackpad comes with three sizes of shims (0.075 mm, 0.125 mm, and 0.175 mm). Start with the 0.125 mm shim.

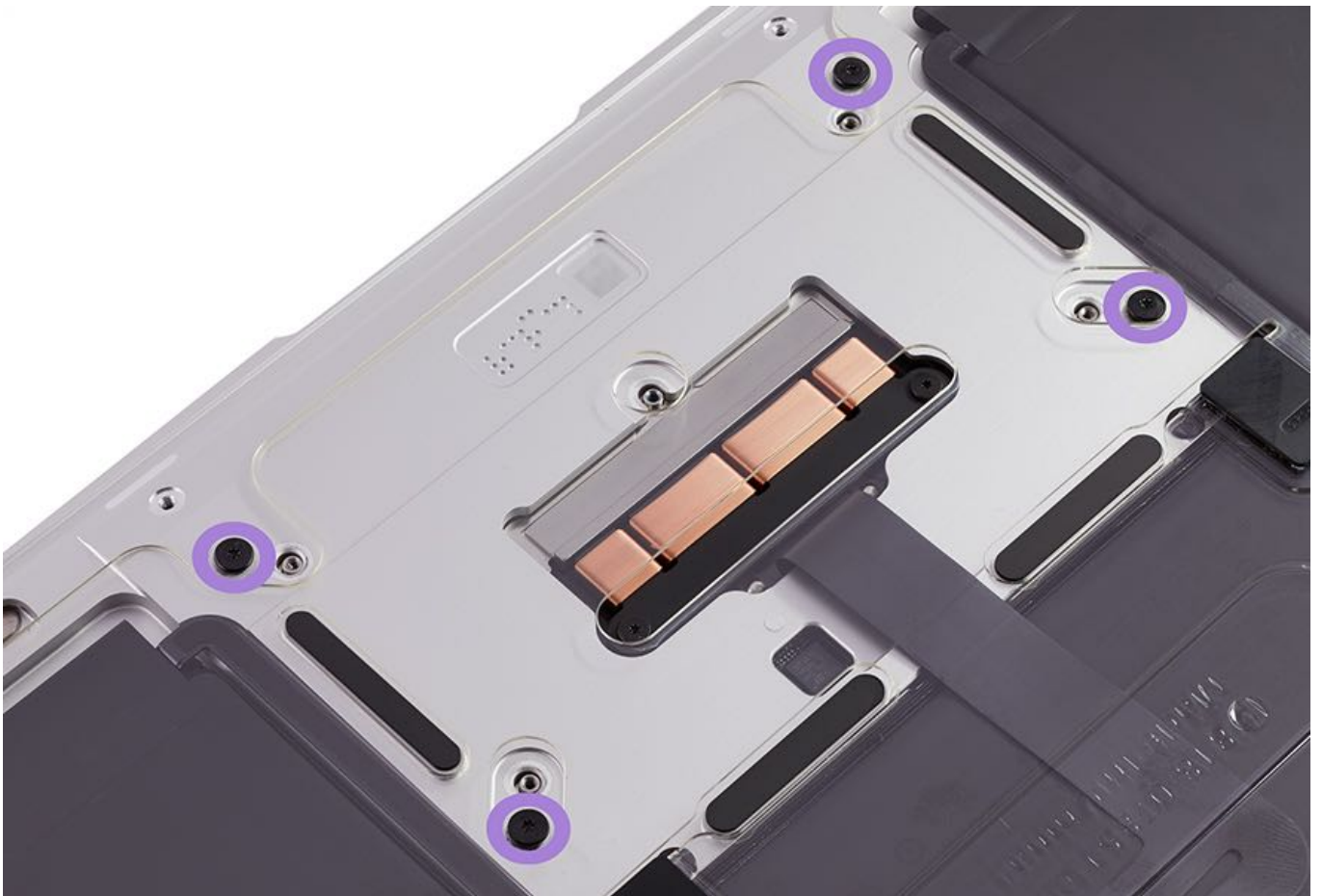




2. Lower the top case over the trackpad while threading the trackpad flex cable through the opening. Align the nine screw holes with the nine screw bosses.



3. Put on the battery cover and install the four outer corner screws about halfway to allow for trackpad alignment.



4. Turn the computer over and insert four gap offset tools in the corners of the trackpad. Place a piece of Kapton tape on each gap tool to keep the tool in place.



5. Place the open computer on its side. Use a T5 screwdriver to tighten the four outer screws.



6. To test the trackpad is at the correct height, align a single Post-It note on the upper edge of the trackpad. Run a finger over the top case and trackpad to verify the trackpad is flush with the Post-It note.



7. Align a stack of two Post-It notes to the bottom edge of the trackpad. Run a finger over the top case and trackpad to verify the trackpad is flush with the Post-It note.



8. If the trackpad is correctly aligned, continue with step 9. If the trackpad is higher than the top case, remove the screws and replace the shims with the thinner 0.075 mm shims. If the trackpad is lower than the top case, remove the screws and replace the shims with the thicker 0.175 mm shims.

9. Place the unit so the display is over the table edge. Insert a T5 security bit into the 0.3–1.2 Nm torque driver. Set the driver to 0.35 Nm. Tighten the middle screw to 0.35 Nm.

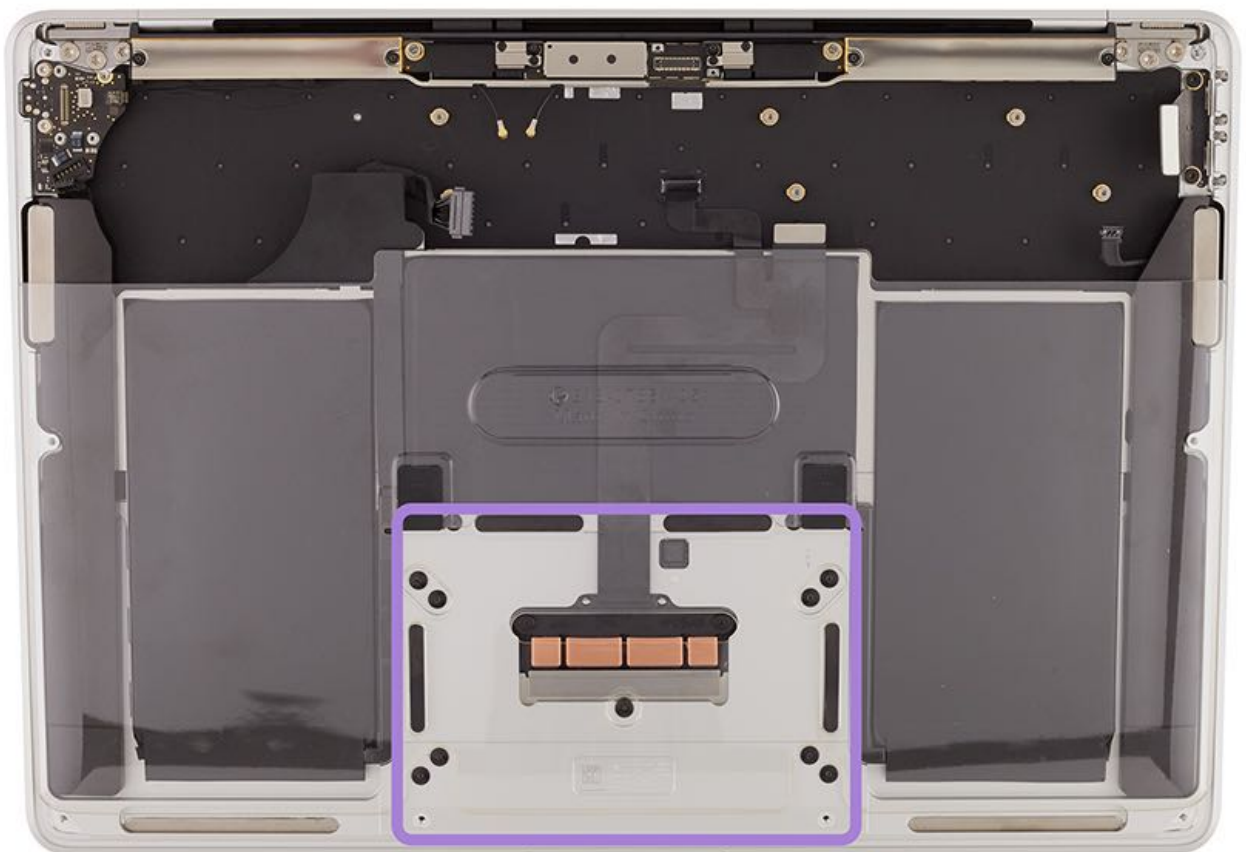
10. Insert the T5 security bit into the adjustable 10–34 Ncm torque driver. Set the torque value to 16 Ncm. Tighten the eight outer screws to 16 Ncm.

11. Turn the computer over and use a black stick to lift off the gap offset tools and the Kapton tape.



12. Reconnect the flex cable to the topcase and gently adhere it to the battery.

13. Turn the computer over and install the battery cover to continue with reassembly.



14. Reinstall the [logic board](#).

15. Reinstall the [bottom case](#).



16. **Caution:** This repair is not complete until the System Configuration has been performed. For instructions, refer to [TP1657: System Configuration for Macs with the Apple T2 Security Chip](#). Failure to perform this step will result in an inoperative system and an incomplete repair.

17. After System Configuration is performed, verify the trackpad performance with Trackpad Calibration Check. For instructions on trackpad calibration, refer to [TP1314: Trackpad Calibration Check](#).

Trackpad Flex Cable

First Steps



Warning:

- Attach the battery cover and disconnect the battery immediately after removing the bottom case.
- Do not apply external power while the computer is under repair.

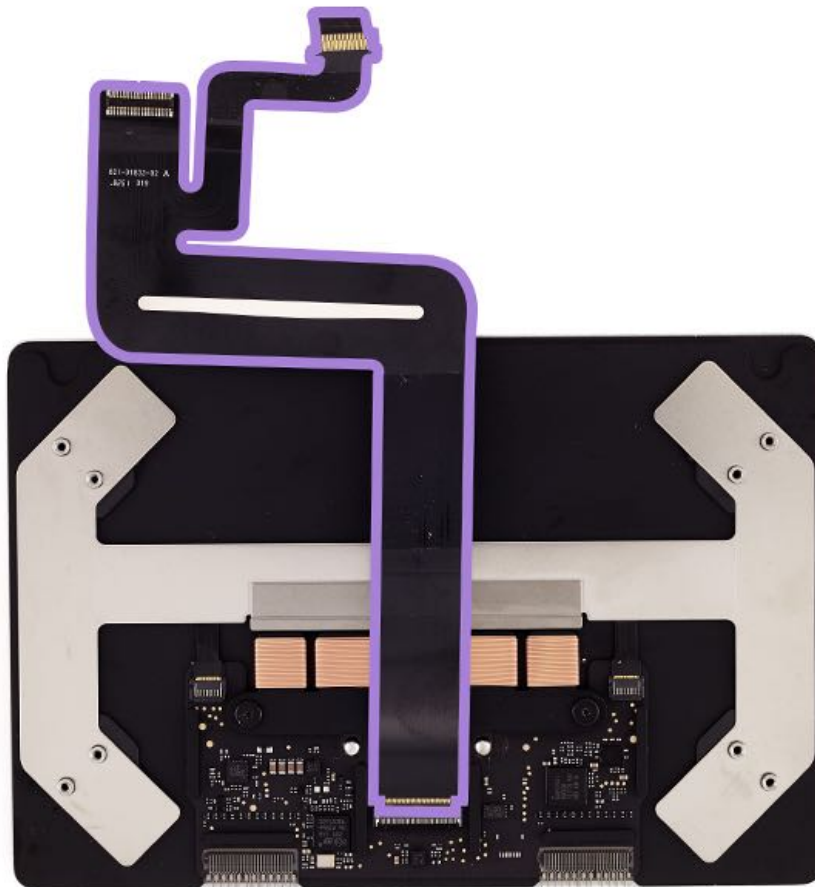
Important:

- Only Apple-certified technicians should perform this procedure. For more information, refer to [OP1859: About Apple service certifications](#).
- Wear an ESD wrist strap and take precautions to avoid ESD.

For video instruction, refer to article [SV391: Trackpad Replacement Video](#).

Remove:

- [Bottom Case](#)
- [Logic Board](#)



Tools

1. Black stick



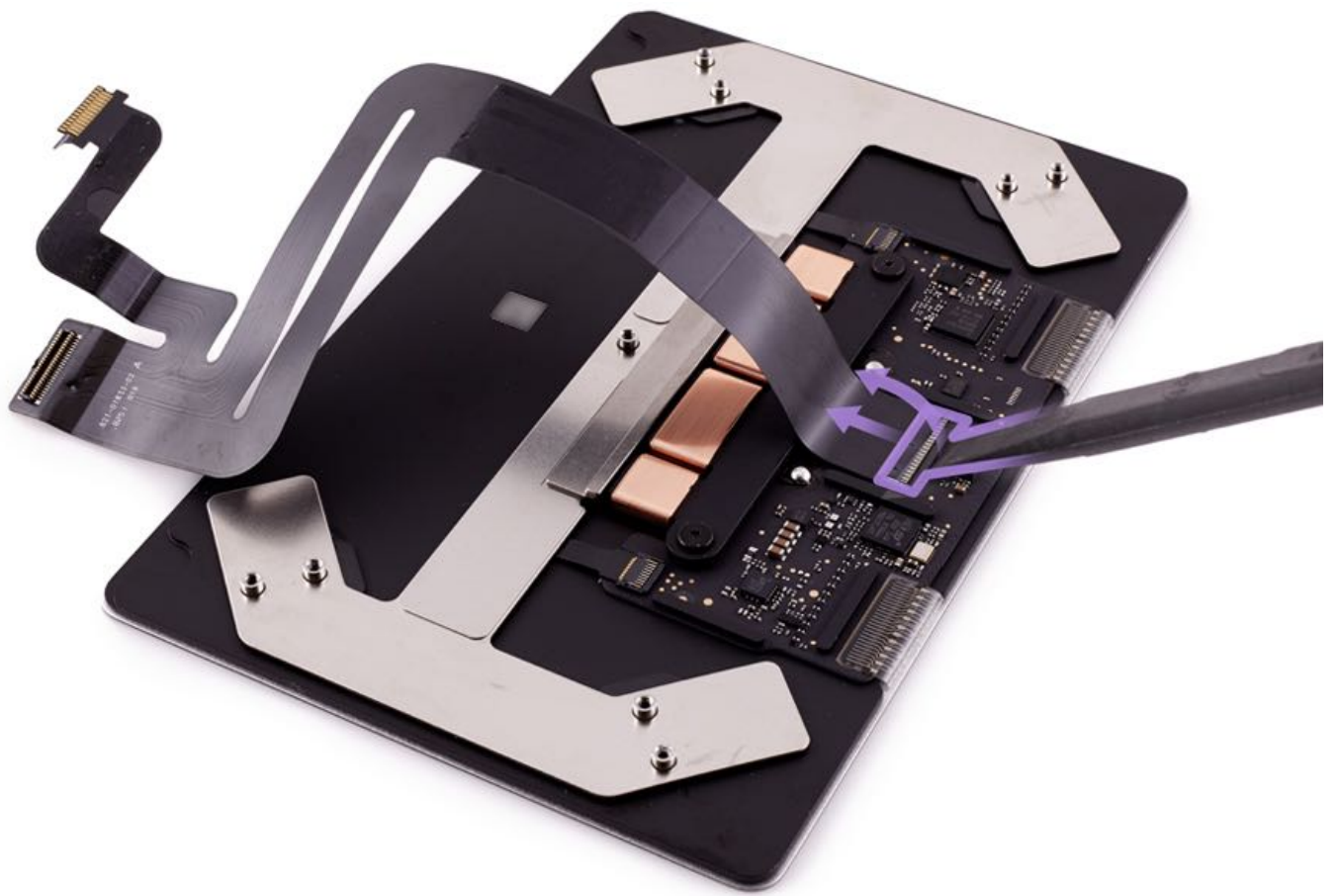
Steps For Removal

Note: If reinstalling the trackpad, do not remove the trackpad flex cable from the trackpad unless it is damaged. If installing a new trackpad, replace the trackpad flex cable with a new one that is included with the replacement part. The replacement trackpad comes with two flex cables. Find the number on the back of the original trackpad and match it to the new one.

- JIS 821-01914
- ANSI/ISO 821-01833



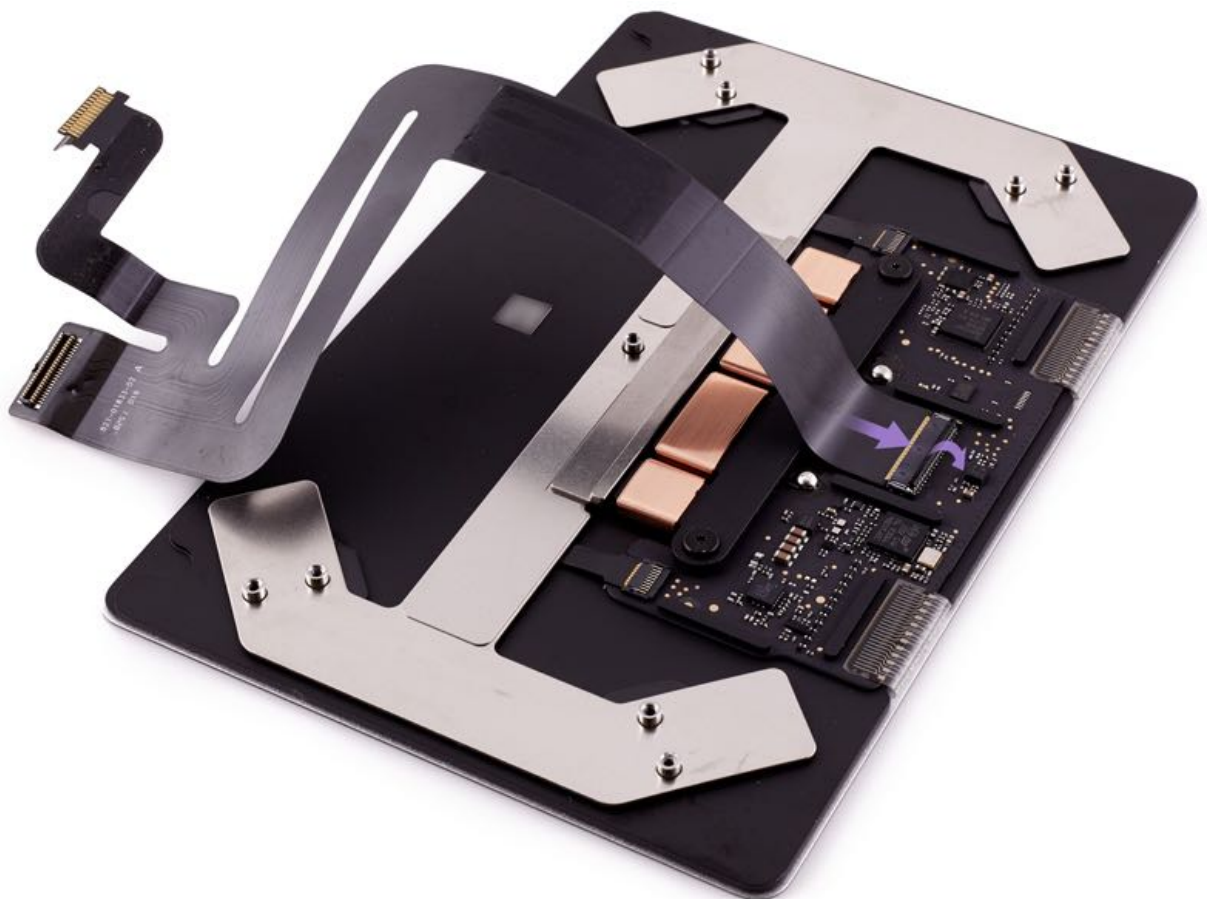
1. Open the locking lever and disconnect the trackpad flex cable from the trackpad.



2. Leave the locking lever open in its upright position for reinstallation.

Steps For Reassembly

1. Insert the trackpad flex cable into the connector on the replacement trackpad.



2. Verify the cable is inserted completely. Close the locking lever.

3. Refer to [RP1462: Trackpad](#) to complete the reassembly.

Top Case Assembly

First Steps



Warning:

- Attach the battery cover and disconnect the battery immediately after removing the bottom case.
- Do not apply external power while the computer is under repair.

Important:

- Only Apple-certified technicians should perform this procedure. For more information, refer to [OP1859: About Apple service certifications](#).
- Wear an ESD wrist strap and take precautions to avoid ESD.

Note: Regional top cases have the same base part number, but they include a language code prefix (for example, Italian = T661-09736). Confirm the correct keyboard language before replacing the top case. To help determine the correct country code and keyboard language, refer to [HT201794: How to identify keyboard localizations](#).

Remove:

- [Bottom Case](#)
- [Logic Board](#)
- [Vent/Antenna Module](#)
- [Speakers](#)
- [Battery](#)
- [I/O Board](#)
- [Audio Board Flex Cable](#)
- [Audio Board](#)
- [Fan](#)
- [Touch ID Board](#)
- [Display Assembly](#)
- [Trackpad](#)



Tools

No tools needed.

Steps For Removal

After all of the first steps are completed, only the top case remains.

These components will also remain in the top case:

- Keyboard
- Microphone

Steps For Reassembly

1. Reassemble:

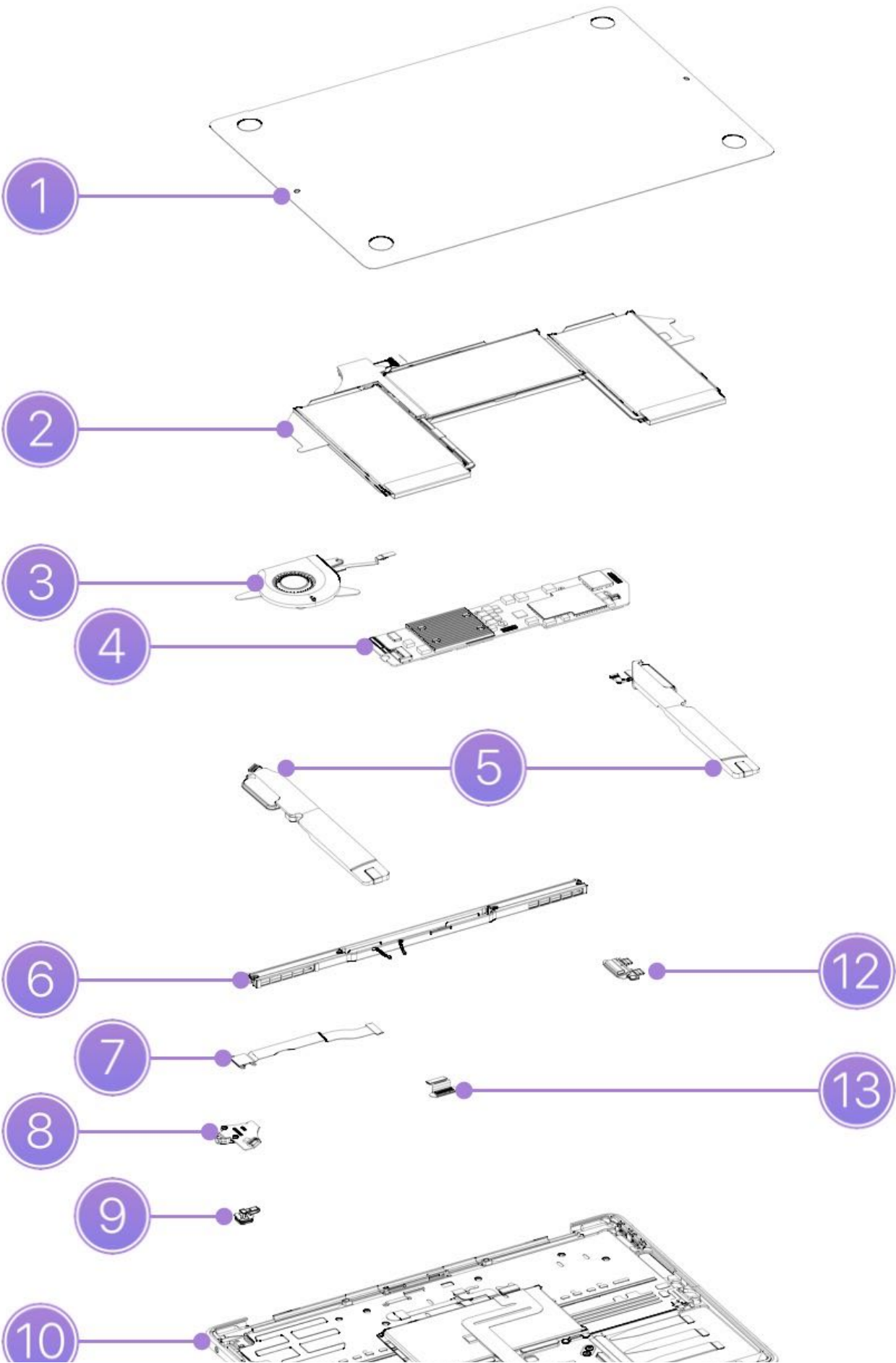
- [Trackpad](#)
- [Display Assembly](#)
- [Touch ID Board](#)
- [Fan](#)
- [Audio Board](#)
- [Audio Board Flex Cable](#)
- [I/O Board](#)
- [Battery](#)
- [Speakers](#)
- [Vent/Antenna Module](#)
- [Logic Board](#)
- [Bottom Case](#)

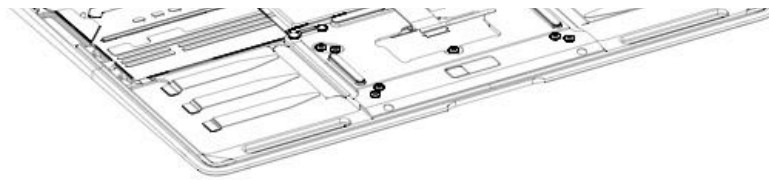
2. **Caution:** This repair is not complete until the System Configuration has been performed. For instructions, refer to [TP1657: System Configuration for Macs with the Apple T2 Security Chip](#). Failure to perform this step will result in an inoperative system and an incomplete repair.

3. After System Configuration is performed, verify the trackpad performance with Trackpad Calibration Check. For instructions on trackpad calibration, refer to [TP1314: Trackpad Calibration Check](#).

Exploded View

Exploded View for MacBook Air (Retina, 13-inch, 2018)





14

11



1. Bottom Case

- 923-02825, Space Gray
- 923-02826, Silver
- 923-02827, Gold

2. Battery

- 923-03022

3. Fan

- 923-02438

4. Logic Board

- 661-09709, i5, 3.6GHz, 8GB, 128GB
- 661-09710, i5, 3.6GHz, 8GB, 256GB
- 661-09711, i5, 3.6GHz, 8GB, 512GB
- 661-09712, i5, 3.6GHz, 8GB, 1.5TB
- 661-09713, i5, 3.6GHz, 16GB, 128GB
- 661-09714, i5, 3.6GHz, 16GB, 256GB
- 661-09715, i5, 3.6GHz, 16GB, 512GB
- 661-09716, i5, 3.6GHz, 16GB, 1.5TB

5. Speaker (pair)

- 923-02441

6. Vent/Antenna Module

- 923-02349

7. Audio Board Flex Cable

- 923-02812

8. Audio Board

- 923-02823, Space Gray/Gold
- 923-02824, Silver

9. Touch ID Board

- 661-11677

10. Top Case with Keyboard

- 661-09736, Top Case with Keyboard, Space Gray
- 661-09737, Top Case with Keyboard, Silver
- 661-09738, Top Case with Keyboard, Gold

Note: Regional top cases have the same base part number, but they include a language code prefix (for example, Italian = T661-09736). Be sure to choose the correct keyboard language when ordering a top case. To help determine the correct country code and keyboard language, refer to [HT201794: How to identify keyboard localizations](#). The language prefixes are:

- | | |
|------------------------------|----------------------------|
| • AB: Arabic | • KH: Korean |
| • B: British (Great Britain) | • MG: Hungarian |
| • BG: Bulgarian | • N: Dutch |
| • C: Canadian French | • PO: Portuguese |
| • CH: Chinese Simplified | • RO: Romanian |
| • CR: Croatian | • RS: Russian |
| • CZ: Czech | • S: Swedish |
| • D: German | • SF: Swiss French |
| • DK: Danish | • SL: Slovak |
| • E: Spanish | • SM: Swiss Multilingual |
| • F: French | • T: Italian |
| • FN: Belgian | • TA: Taiwanese |
| • GR: Greek | • TH: Thai |
| • H: Norwegian Bokmal | • TQ: Turkish (Turkey) |
| • HB: Hebrew | • TU: Turkish (Turkish) |
| • IS: Icelandic | • VN: Vietnam |
| • J: Japanese | • Z: English International |

Top case keyboards may not be available in all localizations.

11. Display Assembly

- 661-09733, Display Assembly, Space Gray
- 661-09734, Display Assembly, Silver
- 661-09735, Display Assembly, Gold

12. I/O Board

- 923-02813

13. eDP Flex Cable

- 923-02440

14. Trackpad
















- 661-11906, Trackpad, Space Gray
- 661-11907, Trackpad, Silver
- 661-11908, Trackpad, Gold






Not pictured:

- 923-02932 - IPD Flex Cable, ANSI/ISO
- 923-02933 - IPD Flex Cable, JIS

Screw Chart

Screw Chart for MacBook Air (Retina, 13-inch, 2018)

<p>923-02817, Silver 923-02814, Space Gray 923-02820, Gold</p> <p>Pentalobe</p>  <p>Bottom Case, Front Center and Sides (6)</p>	<p>923-02818, Silver 923-02815, Space Gray 923-02821, Gold</p> <p>Pentalobe</p>  <p>Bottom Case, Rear Corner, (2)</p>	<p>923-02819, Silver 923-02816, Space Gray 923-02822, Gold</p> <p>Pentalobe</p>  <p>Bottom Case, Rear Center (2)</p>
<p>923-02885 T3</p>  <p>Wireless antennas cowling, IPD flex cowling, eDP cowling, I/O board cowling (2)</p>	<p>923-02924 T3</p>  <p>Battery (4)</p>	<p>923-02925 T3</p>  <p>TCON (2)</p>
<p>923-02886 T5</p>  <p>Fan (1)</p>	<p>923-02887 T5</p>  <p>Fan (2)</p>	<p>923-02881 Torx T5</p>  <p>Audio Board (1)</p>
<p>923-02884 Torx T3</p>  <p>Audio Board (2)</p>	<p>923-02888 Torx T3</p>  <p>Touch ID Flexure (6)</p>	<p>923-02889 Torx T3</p>  <p>I/O Board (2)</p>
<p>923-02890 Torx T3</p>  <p>eDP to Logic Board (2)</p>	<p>923-02891 Torx T5</p>  <p>Logic Board (3)</p>	<p>923-02892 Torx T5</p>  <p>Logic Board (2)</p>

<p>923-02893 Torx T5</p>  <p>Logic Board (1)</p>	<p>923-02894 Torx T8</p>  <p>Display Clutch</p>	<p>923-02895 Torx T3</p>  <p>eDP Cowling (2)</p>
<p>923-02900 Torx T5</p>  <p>Vent/Antenna Module (4)</p>	<p>923-03002 Adjustable torque driver 0.3–1.2 Nm</p>  <p>Trackpad, Center</p>	<p>923-02880 Adjustable torque driver 0.3–1.2 Nm</p>  <p>Trackpad</p>

Screw Location Diagrams

Screw Location Diagrams for MacBook Air (13-inch, 2018)

Bottom Case

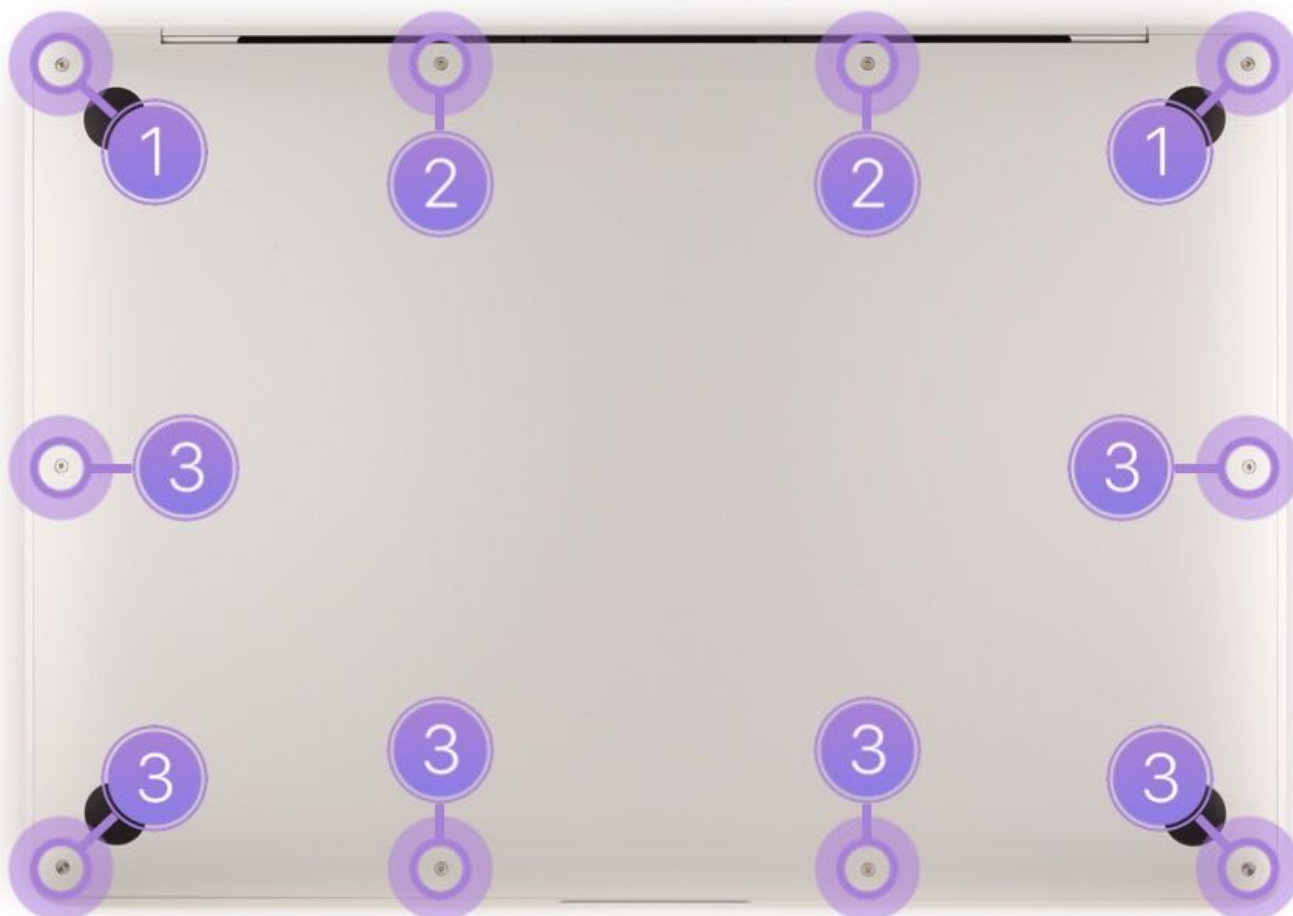
- Pentalobe: (position 1)
 - 923-02818, Silver
 - 923-02815, Space Gray
 - 923-02821, Gold



- Pentalobe: (position 2)
 - 923-02819, Silver
 - 923-02816, Space Gray
 - 923-02822, Gold



- Pentalobe: (position 3)
 - 923-02814, Silver
 - 923-02817, Space Gray
 - 923-02820, Gold

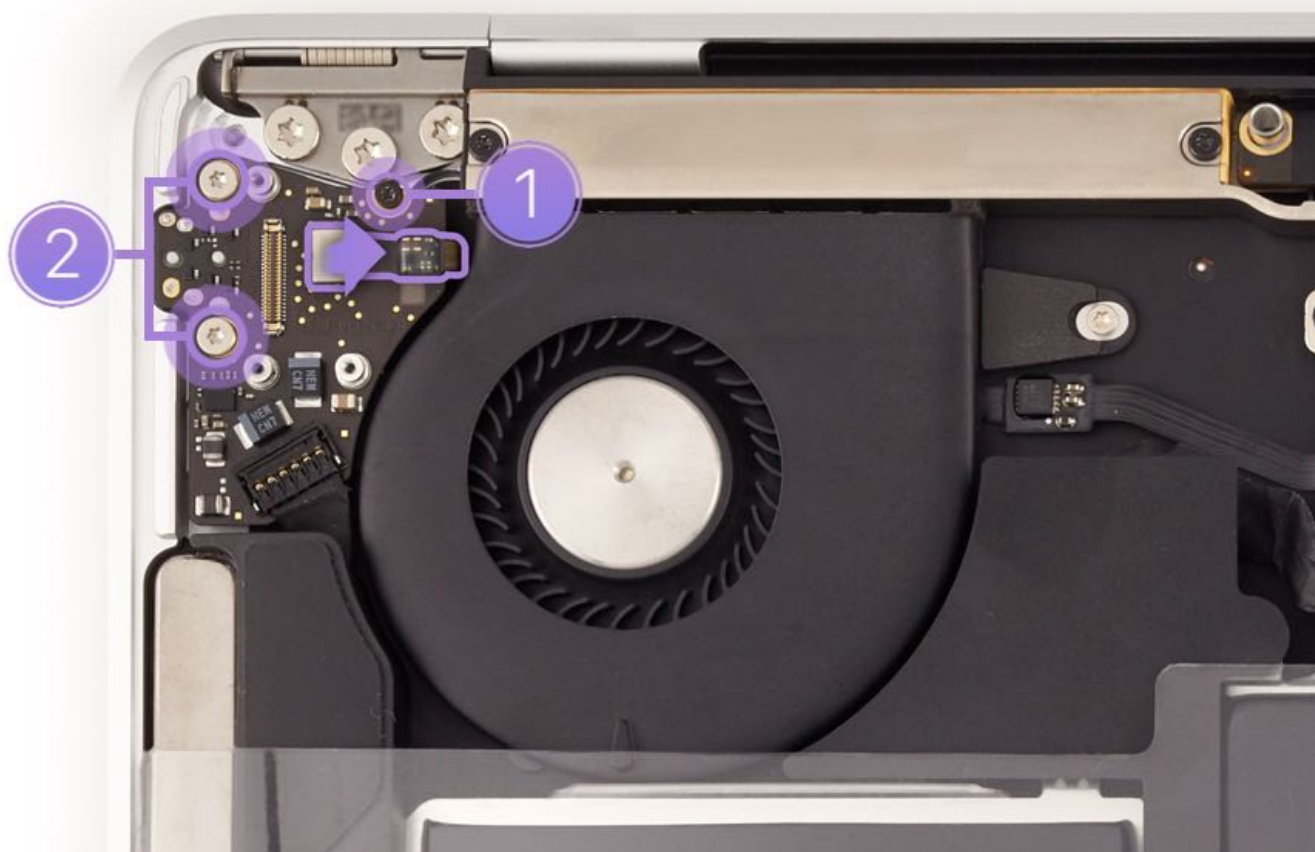


Audio Board

- T3: 923-02884 (1)



- T5: 923-02881 (2)



Logic Board Cowlings

- T3: 923-02885

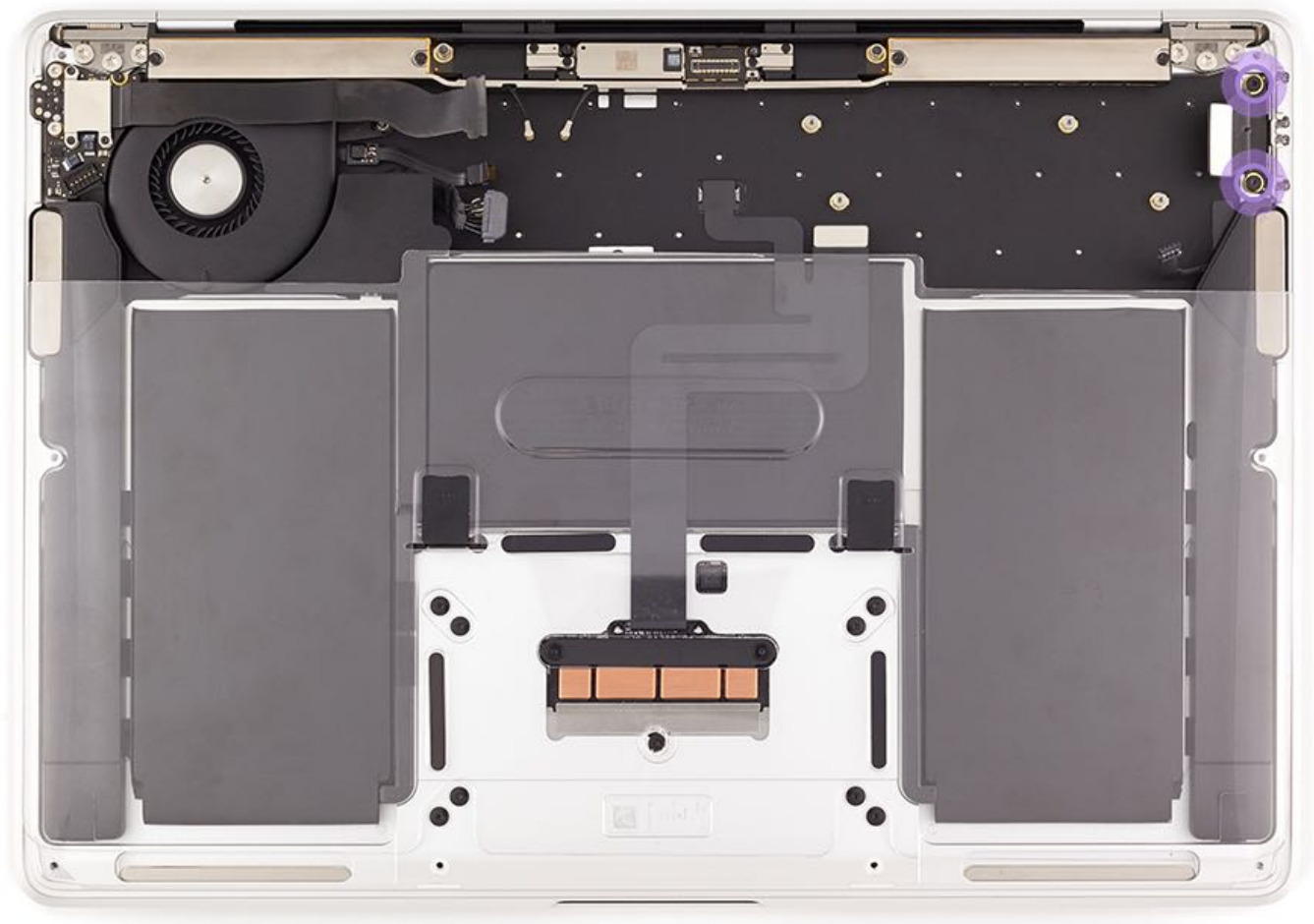




I/O Board

- T3: 923-02889





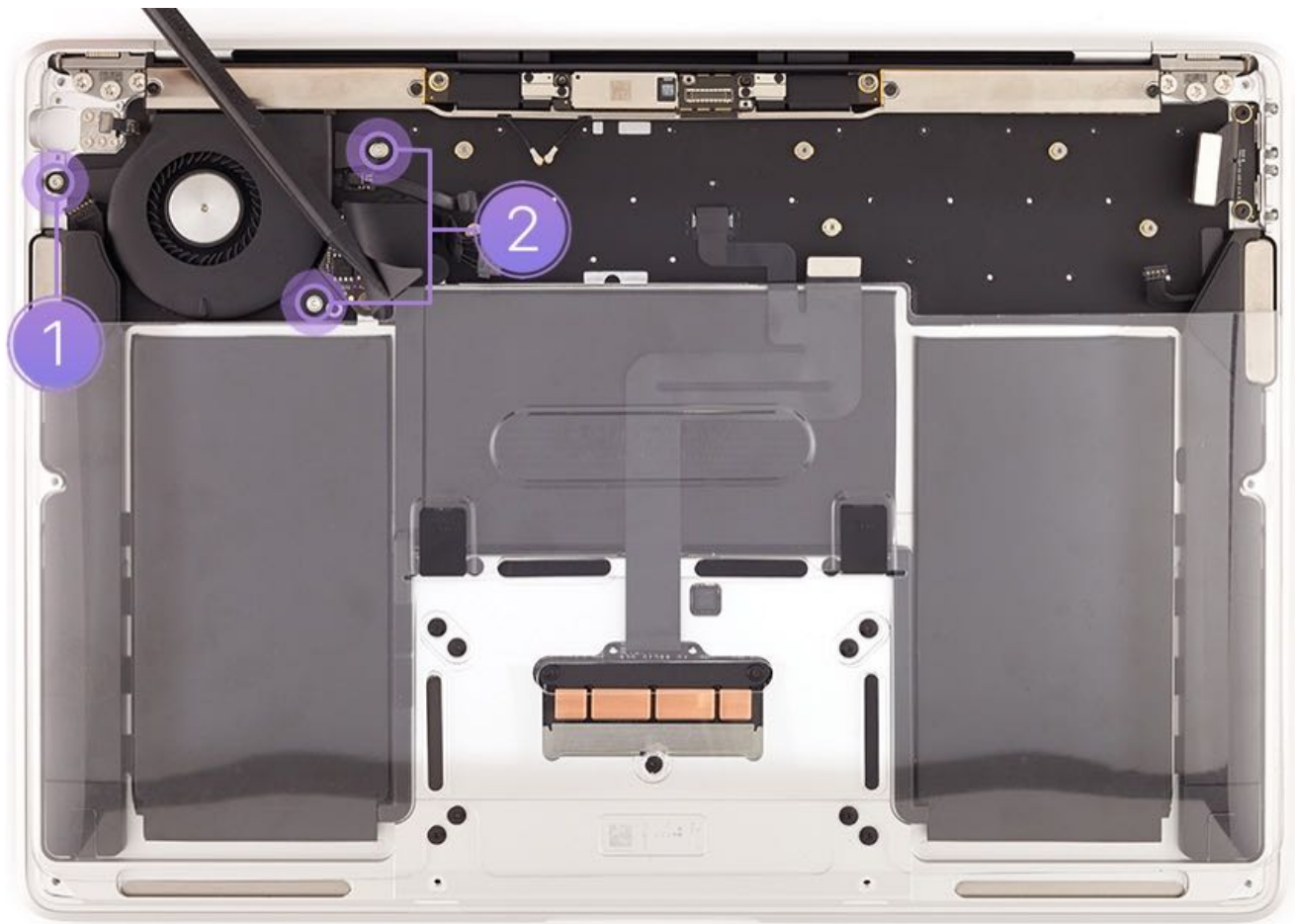
Fan

- T5: 923-02886 (position 1)



- T5: 923-02887 (position 2)

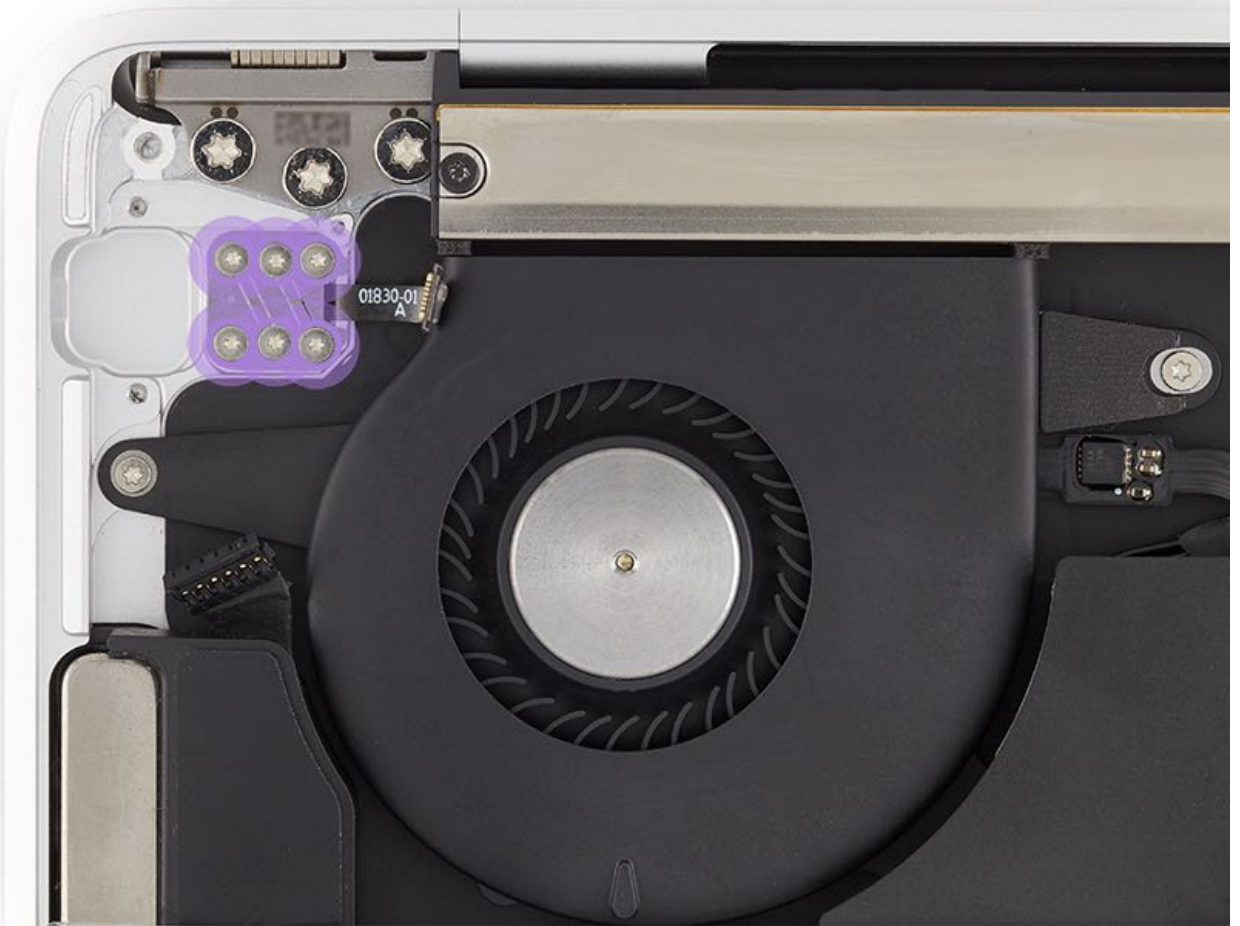




Touch ID Flexure Screws

- T3: 923-02888





Logic Board Screws

- T5: (position 1)
 - 923-02891

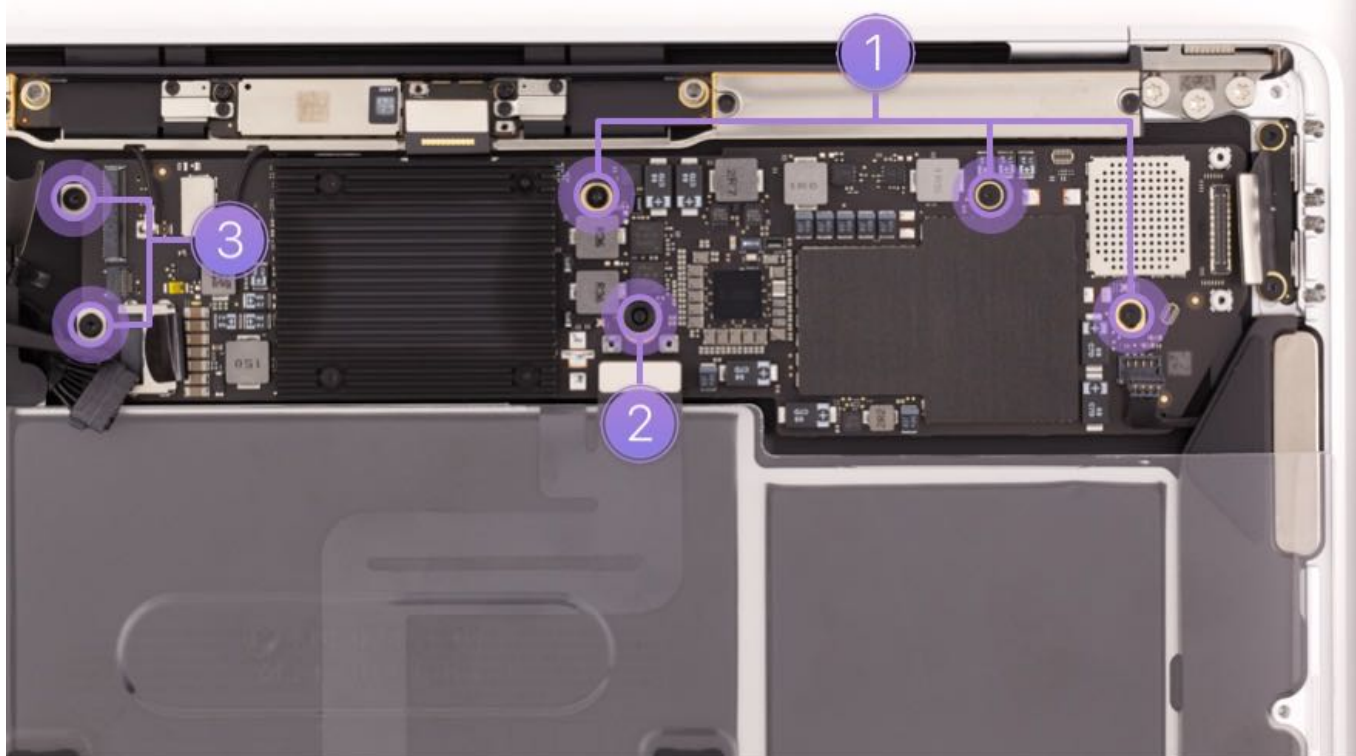


- T5: (position 2)
 - 923-02893



- T5: (position 3)
 - 923-02892



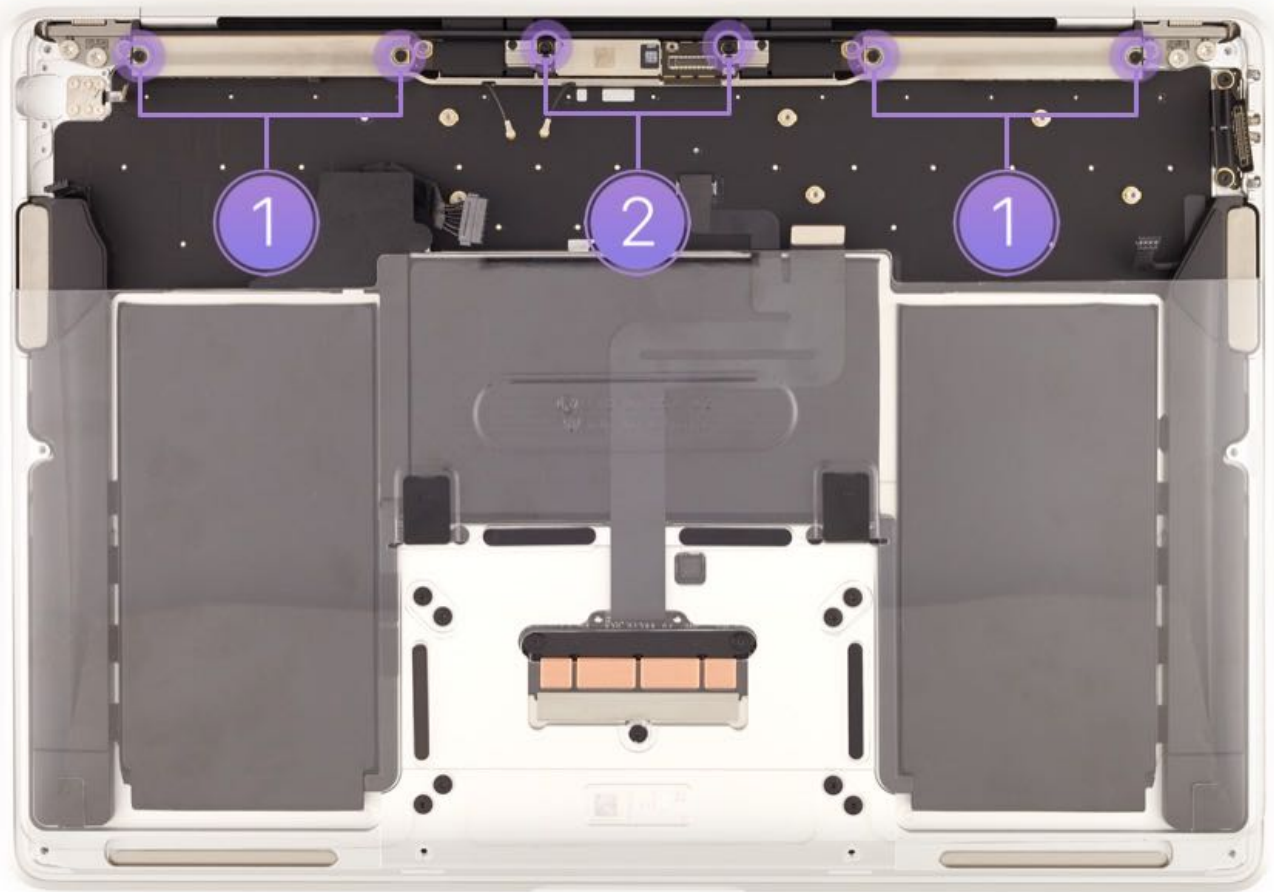


Vent/Antenna Module

- T5: 923-02900 (4) (position 1)



- T5: 923-02925 (2) (position 2)



Display Hinge Screws

- T8: 923-02894

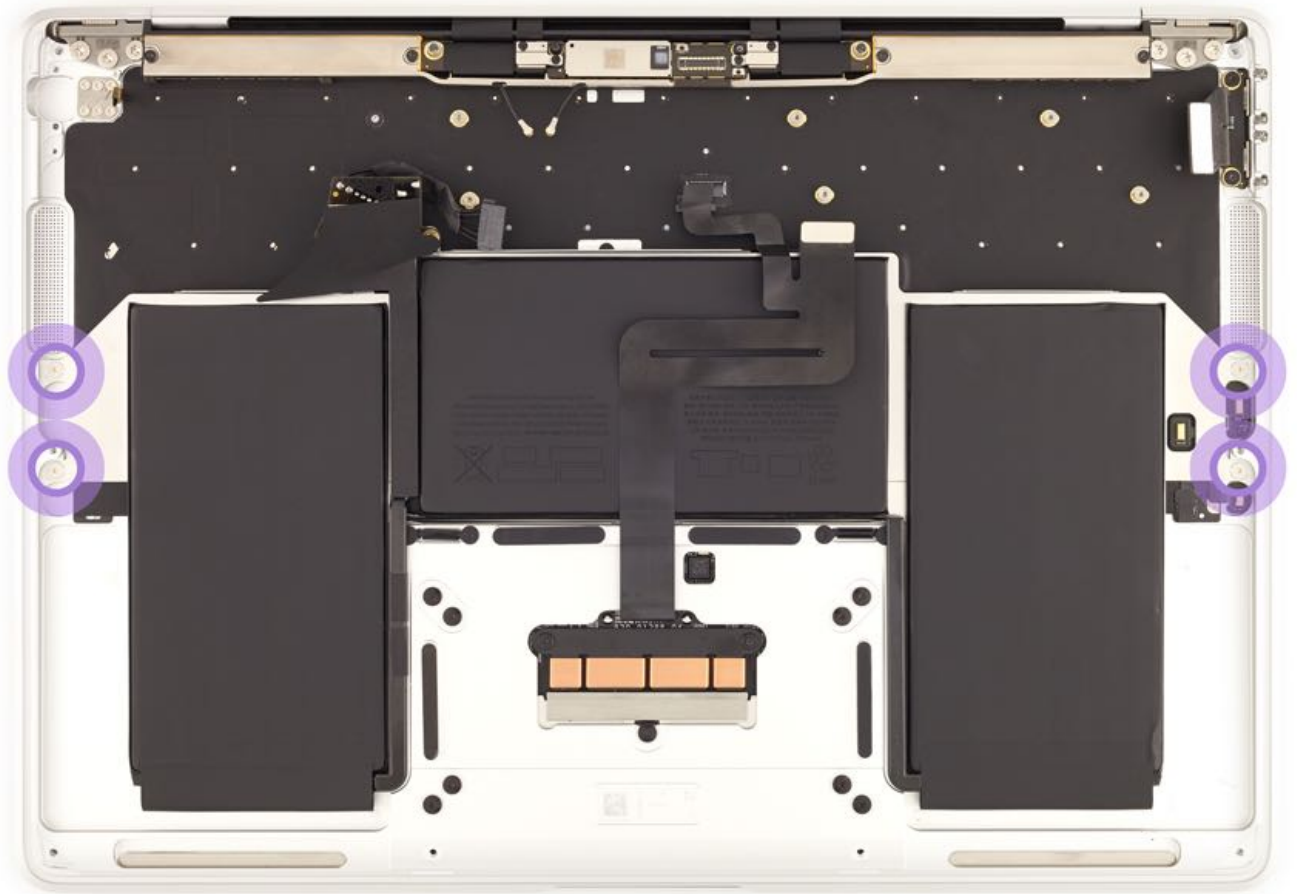




Battery

- T3: 923-02924



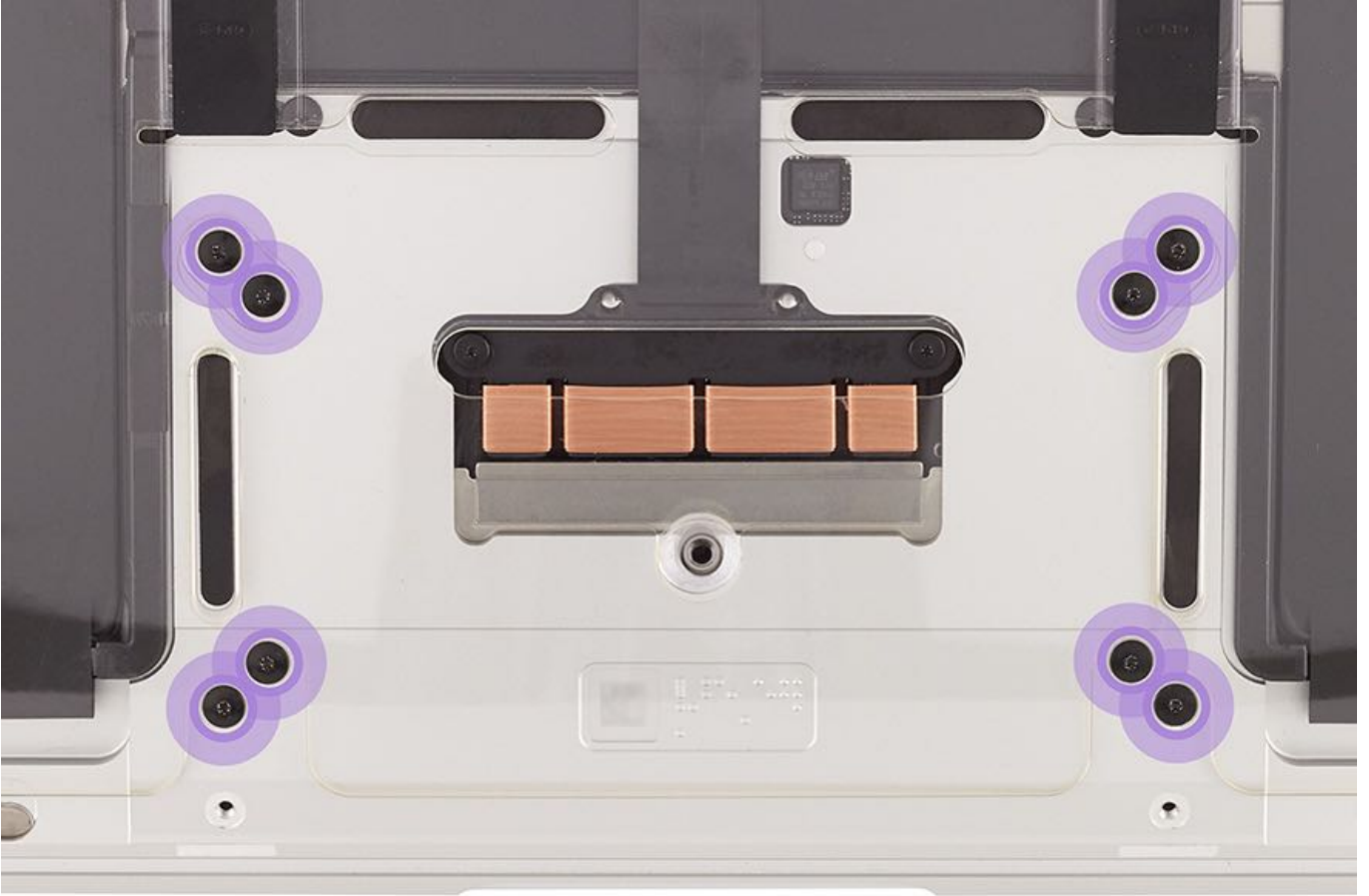


Trackpad

- T5: 923-03002 (center)



- T5: 923-02880 (outer)



External Views

External Views

Thunderbolt 3 Ports



Audio Jack



Bottom Case View

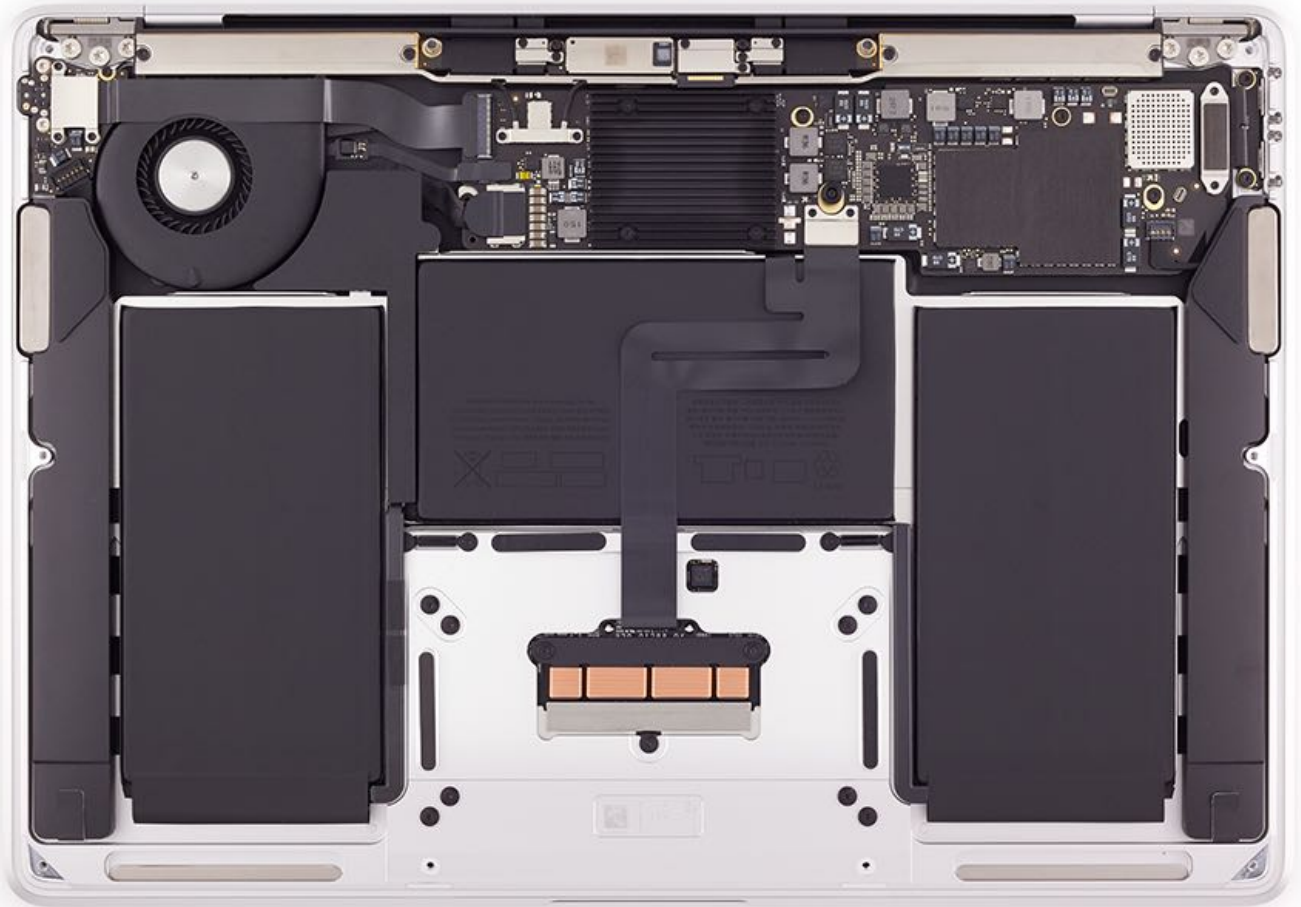
You can identify MacBook Air (Retina, 13-inch, 2018) by the model number and EMC number on the bottom case:

- **Model Number:** A1932
- **EMC Number:** 3184



Internal View

Internal View of MacBook Air (Retina, 13-inch, 2018)



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